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Mary B. Hathaway.
New Bedford -
1878 -



FRONTISPIECE.



E. N. PRABODY, PHOTO.

THE FERN CORNER,

In the writers Conservatory.—See Description of Plates.

1

FERNS

IN THEIR HOMES AND OURS.

BY

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Dedication.



I DEDICATE THIS LITTLE BOOK

To My Friend,

EDWIN COURTLAND BOLLES,

AS A SLIGHT ACKNOWLEDGMENT

FOR THE ASSISTANCE HE HAS SO KINDLY
RENDERED ME IN ITS
PREPARATION.

J. R.



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INTRODUCTION.

FERN-CULTURE in America has still the characteristics of novelty, although ferns have long been favorites in other lands; for some of our New-England species have been under cultivation in Old England for two hundred and fifty years. John Tradescant introduced into Europe, in 1628, the *Cystopteris bulbifera* and the Maiden-hair (*Adiantum pedatum*); while other species, including the Walking-Leaf Fern (*Camptosorus*) and the Sensitive Fern (*Onoclea*), soon followed. In the Kew Gardens at London, about the first of the present century, there were eighty-three species of exotic ferns under cultivation, while at the same time there were thirty species in the Botanic Garden at Berlin; and in 1866 the collection at Kew numbered more than a thousand species of exotic ferns. Besides the large collections of famous public institutions, there have been and are many private collections of ferns in

England which rival and even surpass them. The competition is there so keen in obtaining fine specimens of rare ferns, that as much as fifty guineas (\$250) has been paid for a single plant. It is not therefore to be wondered at, that, in countries where ferns have so long been under cultivation, numerous works upon the subject of their structure, growth, and culture, have appeared.

In America there are but few large special collections of ferns, although there are many smaller ones as well as individual specimens of rare excellence. The beautiful ferns, palms, and other rare plants, exhibited by Mr. Such of New Jersey, in a side-room of the Horticultural Building at the Centennial Exhibition at Philadelphia, was the one redeeming thing among the contents of that great structure ; at least, at the time of the writer's visit in June, 1876. This was unfortunate, as it misrepresented the condition of American horticulture, besides being a severe criticism on the patriotism of American horticulturists.

There has not yet been published in this country any work devoted exclusively to the cultivation of ferns. There is, therefore, less hesitation on the writer's part in presenting to the public this little book, in which he has endeavored to adapt the subject and its illustrations to the wants of persons in the United States. He has, during the last ten years, followed in practice the theories and

suggestions of the numerous English treatises on fern-culture ; and, without pretending to compete with these numerous and valuable as well as expensive works, he trusts that this volume may be of service to those in this country who desire to cultivate ferns, and need a guide especially adapted to the circumstances of their home.

By introducing the subject with two chapters on the growth, structure, and classification of ferns, an attempt has been made to impress the mind of the beginner with an idea that a knowledge of these subjects will vastly add to his success.

Numerous authors are quoted in the following pages, and it is believed that due acknowledgment has been made in every case where use has been made of the thoughts of others.

The writer desires to express his gratitude to those who have aided and encouraged him during the preparation of the book. Among such friends are T. F. Hunt, Esq., who has kindly furnished the materials for some of the best designs given in the plates ; and Dr. A. S. Packard, jun., who has not only furnished the valuable plate illustrating the insects which destroy ferns, but has also kindly revised the chapter upon this subject, and added several points of value. Mr. Emerton has given great care to the drawing of the illustrations, and has certainly succeeded in making them all that could be desired.

The reader as well as the writer is much indebted to Rev. E. C. Bolles of Salem for his work in revising the writer's manuscript. And last, but not least, the writer desires to express his appreciation of the liberality of the publisher, Mr. Cassino, who has without objection several times amended the original plan of the book, although the changes have added considerably to the expense of publication.

2 CHESTNUT STREET, SALEM,
June 1, 1878.





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ABBREVIATIONS.

AUTHORITIES.

A. Br.	A. Braun.
Bernh.	Bernhardi.
Boisd.	Boisduval.
Br.	Robert Brown.
Cav.	A. J. Cavanilles.
Col.	W. Colenso.
Desv.	N. A. Desvaux.
Forst.	John Reinhold Forster.
H. & G.	Hooker & Greville.
Hk. or Hook.	Sir William Jackson Hooker.
H. B. K.	Humboldt, Bompland, and Kunth.
Hort.	Of garden origin.
Hoffm.	G. F. Hoffmann.
J. Sm.	John Smith.
Klf. or Kaulf.	G. F. Kaulfuss.
Klotz.	Dr. Klotzsch.
L. or Linn.	Linnæus.
L. & F.	Langsdorf & Fischer.
Lam.	J. Bapt. Monet de Lamark.
Labill.	J. J. Labillardière.
Linn. f.	Linnæus' son.
L'Hérit.	C. L. L'Héritier.
Mett.	Dr. G. Mettenius.

Michx.	Michaux.
Nutt.	Dr. Nuttall.
R. Br.	Robert Brown.
Rich.	J. L. Richard.
Sm.	Sir James Edward Smith.
Spr. or Spreng.	C. Sprengel.
Sw.	Olaf Swartz.
Wall.	Dr. Nathaniel Wallich.
W. or Willd.	C. L. Willdenow.

WORKS REFERRED TO.

Beddome, F. S. I. . . .	Beddome's Ferns of Southern India.
Beddome, F. B. I. . . .	Beddome's Ferns of British India.
Eaton, Ferns N. A. . . .	Eaton's Ferns of North America.
Gard. Chron.	Gardener's Chronicle, London.
Hk. Ex. Flo.	Hooker's Exotic Flora.
Hk. G. F.	Hooker's Garden Ferns.
Hk. Fil. Ex.	Hooker's Filices Exoticæ.
Hk. 1st Cent. F.	Hooker's First Century of Ferns.
Hk. 2d Cent. F.	Hooker's Second Century of Ferns.
Hk. Sp. Fil.	Hooker's Species Filicum.
H. & G. Ic. Fil.	Hooker & Greville's Icones Filicum.
Lowe	Lowe's Ferns, British and Exotic.
Lowe, N. & R. F.	Lowe's vol. ix., or New and Rare Ferns.

TERMS.

fig, figure; ft., foot or feet; fr., frond; in., inch or inches; pl., plate.





LIST AND DESCRIPTION OF PLATES.

FRONTISPIECE. — Corner of the writer's greenhouse, with *Blechnum Brasiliense* in centre; *Lomaria gibba* and *Platyserium alaicorne* below. The bell-glass covers a pan of *Trichomanes radicans*. Hanging-baskets to the left. *Ficus repens* on the wall, and *Selaginella*, *Adiantums*, and *Panicum variegatum* in foreground. Young plant of *B. Brasiliense* at lower right-hand corner, and directly above it *Nephrodium setigerum*.

PLATE I. — Out-of-door fernery.

PLATE II. — *Notholaena dealbata*, Kunze.

PLATE III. — Growth of a fern (*Pteris serrulata*, Lin. f.) from the spore (figs. 5-18), as compared with that of a squash from the seed (figs. 1-4). 1, squash-seed; 2, the same with one cotyledon removed, showing the embryo; 3, the same in longitudinal section to show plumule and radicle; 4, the same after one week's growth; *Pteris serrulata* (after Moore), 5, spore; 6-9, growth of *prothallus*; 9 a, antheridia; 9 b, archegonia; 10, two antheridia enlarged, the one at the right empty; 11, one cell of antheridium containing a single antherozoid; 12, antherozoid enlarged; 13, archegonium, longitudinal section to show germinal vesicle; 14, the same seen from above; 15, plant-bud starting underneath the prothallus (after Sachs); 16-18, various stages of young plant's growth.

PLATE IV. — *Pellea densa*, Hk.

PLATE V. — Fern-structure (after Smith, Sachs, Hooker). 1, enlarged spore-case of *Polypodium*; 2, ditto of *Gleichenia*; 3, ditto of *Schizaea*; 4, sorus of *Polypodium*; 5, spore-case of *Os-*

munda, enlarged; 6, sorus of *Marattia*, enlarged; 7, sorus of *Aspidium*, enlarged; 8, portion of a frond of *Gymnogramme*, enlarged to show the fruiting; 9, fruit of *Pteris*; 10, stem of *Pteris*, *a*, frond of the present season; *b*, frond for next season; *c*, continuation of stem; *d*, the leaf-bud for the third season; 11, root of a fern; *a*, root-cap; *b*, point of growth; *c*, older portion of root.

PLATE VI. — *Cheilanthes Cooperæ*, Eaton.

PLATE VII. — *Dicksonia antarctica*, Labill. From a plant six feet high.

PLATE VIII. — 1, saucer and bell-glass, and, 2, pan and glass, for raising sporelings; 3, tall flower-pot; 4, pan showing holes for drainage; 5, open-work pan; 6, flower-pot, with flattened back; 7, ordinary flower-pot.

PLATE IX. — Window jardinière.

PLATE X. — *Cheilanthes lanuginosa*, Nutt.

PLATE XI. — Iron-framed fernery.

PLATE XII. — *Cheilanthes Californica*, Mett.

PLATE XIII. — Eastlake fernery.

PLATE XIV. — *Camptosorus rhizophyllus*, Link.

PLATE XV. — Home-made fernery: 1, side-view complete; 2, corner; 3, 4, sections to show method of construction.

PLATE XVI. — *Asplenium ruta-muraria*, L.

PLATE XVII. — Fernery with base of black stone-ware.

PLATE XVIII. — 1, Cocoanut-shell basket; 2, Japanese fern-stand; 3, Russian fern-stand.

PLATE XIX. — *Botrychium Lunaria*, Sw.; *Botrychium boreale*, Milde; showing enlarged fruit of the latter.

PLATE XX. — 1, cocoanut-husk with stag-horn fern; 2, wire basket with *Davallia*; 3, wire cylinder with ferns, showing method of construction.

PLATE XXI. — Chinese fern-stand.

PLATE XXII. — Fern-pests (cuts loaned by Dr. Packard): 1, *Aleurodes vaporarium*, Westwood, and, 4, pupa of the same; 2, *Heliothrips hamorrhoidalis*, Haliday; 3, *Abia caprifolii*, Norton; 5, *Lecanium platycerii*, Packard; 6, *Coccus adonidis*, L.; 7, *Lecanium filicum*, Boisd., seen from beneath; 8, the same seen from above; 9, *Aphis*. All the figures are more or less magnified.



CHAPTER I.

THE LIFE OF A FERN.

TO make a proper study of the life-history of a fern would require more space than the few pages which can be allotted to the subject here. And, besides, no thorough investigation of the matter could be made without a careful microscopic examination of the fern itself in all its forms and at the various stages of its growth. A glance at the subject will, however, be better than nothing : so let us begin at once by examining the *spore* from which the fern originates.

The spores of cryptogamous plants are the same in *purpose* and *use* as the seeds of flowering plants ; but in *structure* a seed and a spore are very different. A seed contains a definite embryo or rudimentary plant of the kind which is to be produced by its growth. Take, for example, the seed of a squash (Pl. 3, Figs. 1-3). Open it, and, besides the two large *cotyledons* or seed-leaves, we find between them the bud (*plumule*) which is to

form the vine; and, below this, the little point (*radicle*) which is the beginning of the future root. But in a spore (Pl. 3, Fig. 5), no matter how highly it may be magnified, there is nothing to be distinguished, except the bit of protoplasm contained within a membrane or cell-wall, which forms the outer coat or covering of the spore. Hence it may at once be seen that the method of the fern's growth must, at the outset and very materially, differ from that of an ordinary flowering plant. To establish, however, all the relations between the lower and the higher forms of plant-life, to specify their analogies and define their differences, can only be done by careful observation of the lower orders of Phanerogams (flowering plants), as well as the higher orders of Vascular Cryptogams; and, when this was made, we should find the fact very evident, that in passing from the lowest to the highest forms the ascent was so gradual as to make it extremely difficult to draw the line of separation between Phanerogams and Cryptogams, no matter how widely-isolated specimens from each might appear to differ.

The spores of ferns are to be looked for in most species on the back or under side of the fronds, or, in others, on more or less contracted and altered fronds. When ripe, the spores will fall upon a paper on which a fertile frond is left to dry. If we select such a frond, and examine it with a

pocket lens (one that will magnify eight or ten diameters will answer), we shall generally find that the spores fall from little cases (*sporangia*), which are collected in groups (*sorus*, pl. *sori*). These (see Pl. 5, Fig. 7) are usually on or at the termination of a little vein. Sometimes they are in circular patches on the vein, and unprotected by any covering, as in *Polypodium* (Pl. 5, Fig. 4); sometimes they are covered or protected by a little membrane, which may be attached at the centre as in *Aspidium* (Pl. 5, Fig. 7), or on one side as in *Asplenium*. Sometimes the cases are in lines along the whole length of the vein, as in the California Gold-Fern (*Gymnogramme triangularis*) (Pl. 5, Fig. 8); or along the entire edge of the leaflet (pinnule), as in *Pteris* (Pl. 5, Fig. 9); or, again, along the edge in detached groups, as in the Maiden-hair (*Adiantum*). The sporangia of ferns are found to have five quite distinct forms, upon which the Orders are founded. With the largest order, the *Polypodiaceæ*, the spore-cases are stalked, and have around them a vertical ring of cells more elastic than those of which the rest of the case is composed (Pl. 5, Fig. 1). When the spores are ripe, this ring contracts, rupturing the case, and allowing the spores to be discharged into the air, where they fly off like dust. The common *Polypodium*, *Aspidium*, and *Asplenium* are illustrations. With the *Lycopodiums* and *Anemias* the spore-cases are sessile

in rows, and are minute nut-like bodies, with the elastic ring around the upper portion (Pl. 5, Fig. 3). With the *Osmundas*, again, the spore-cases are stalked; but the ring is represented by a rudiment on one side only (Pl. 5, Fig. 5). With the *Gleichenias*, an order not represented by any native North-American species, the ring is perfect, but passes horizontally around the spore-case (Pl. 5, Fig. 2). This order comprises many beautiful tropical ferns of a climbing habit. With the *Marattaceæ* the spores are in pod-like cases quite unlike those of other ferns (Pl. 5, Fig. 6): in fact, the difference is so great, that Sachs, in his "Text-Book of Botany," contemplates their removal to a separate class by themselves, although most of their characters agree with the regular type. The *Botrychiums* (Pl. 19) (*Ophioglossaceæ*) differ so much from ferns in general, and it is so clear, as shown by Sachs, that they belong to another class of plants, that we will for the present pass them by, and consider them at a later moment among the Fern Allies.

Among ferns of the various orders, the mode of development from the spore is not always exactly the same. There is not sufficient difference between them, however, to prevent us from considering *Pteris serrulata*, the one we have chosen as an example, to serve as an illustration of all. The spores of ferns should usually be sown soon after they are ripe. Some, however, are said to retain

their vitality for several years, as it has been found possible to develop plants from the spores of herbarium specimens. After the spores have been placed in some suitable receptacle for a few days, or perhaps weeks, a greenish scum will be noticed covering the damp surface on which they have been sown. This is the first stage of fern growth. It occurs thus: The outer cell-wall (*exospore*) is ruptured by the moisture, and the cell-contents (*endospore*) protrude, and begin to divide, the division forming new cells, which join themselves to the first. A continuance of this process gives rise, successively, to the various forms shown in Pl. 3, Figs. 5-9, until bodies are produced which are shown highly magnified in Figs. 10-14. These little shield-shaped structures grow very thickly together, and are attached to the earth, or whatever substance they have taken to germinate upon, by root hairs,—not true roots. They rest at such an angle here, that they become imbricated, and, except that they are somewhat more erect, resemble in this arrangement the scales on a butterfly's wing, or the slates upon a roof. The *prothallus*, as each of these bodies is called, is composed of cells containing grains of *chlorophyll*, which gives the whole its green color. On the *prothallus*, projecting from the under side, are the organs which are analogous to the stamens and pistils of flowering plants. They are, I. The

antheridia, which are situated rather more than half way between the little notch or sinus at the upper edge of the *prothallus* and the lower edge. They consist of cells more rounded than the rest, and which contain still other and smaller cells. Each of these last contains, in its turn, one spirally-coiled *antherozoid* (see Pl. 3, Figs. 10-12). When the *antherozoids* are perfected, the enveloping cells burst, and they are set free. They are the male element, analogous to the pollen of flowers. II. The *archegonia*, or those organs which are analogous to the pistils of flowers with their ovaries, are usually less numerous than the *antheridia*, and are situated nearer the sinus of the *prothallus* (Pl. 3, Figs. 13-14). They consist of cells so arranged as to form a tube around a central cell, which is called the *öosphere*, and is the point to be fertilized and produce the plant-bud. The outer end of the tube remains open till fertilization has taken place, after which it closes. In the particular species we have chosen for observation, the *antheridia* and *archegonia* are usually on the same *prothallus*: but in some species the male and female organs are on different *prothalli*; or, at least, not perfected at the same time on the same one. This renders cross-fertilization occasionally necessary in this class of plants, and shows the possibility of finding hybrid ferns, of which, as stated in the next chapter, our *Asplenium ebenoides* is by many

authors supposed to be an example. However the case may be, the *antherozoids* find their way at last to the entrance of the tubes of the *archegonia*, and force themselves in and down to the *oöspheres*, which thus are fertilized. The true growth of the fern, as we see it, now begins from the fertilized *oösphere*. The roots are formed, and pass downward; the leaf-bud assumes shape, and, being partially inverted, curves upward, taking its natural position, as shown in Pl. 3, Figs. 15-18. The central portion of the *prothallus*, where the plant-bud starts, grows thicker than the portion nearer the edge, where there is hardly more than one tier of cells. This thickened part is by some authors called the cushion. In some ferns the antheridial cells are found on the outer portion of the *prothallus*, forming projections there. With the Filmy Ferns (*Hymenophyllaceæ*) the structure and mode of growth is in many ways different from these sketched, affording resemblances to certain genera among the mosses. Although there may be several *archegonia* on each *prothallus*, it rarely happens that more than one of them is fertilized: therefore but one plant is usually produced from a single spore. Professor W. G. Farlow has discovered that there is also a reproduction by a sort of budding process, which sometimes takes place on the *prothalli* of ferns, and is analogous to the office of buds on the

leaves of *Begonia* and *Bryophyllum*, as alluded to hereafter. This discovery was described to the Linnæan Society of London, in 1874, in a paper there read by Professor Farlow. In "Ferns, British and Foreign," by John Smith, London, 1866, is the following interesting paragraph: "Another point of some practical importance is, that, in general, only a single plant-bud is formed on each prothallium. This may be supposed to be owing to the vital function of the prothallium not being able to support more, — in that respect analogous to only one ovulum being fertilized in the ovaries of many flowering plants. Admitting that, then how are we to explain, that, in removing the plant-bud, a new bud is formed, and that even as many as eight or ten have been obtained from prothallia of *Hymenophyllum crinitum*, each of which by proper care becomes a plant? Then, again, experiments have shown that by dividing the prothallium from the base upwards, with a sharp instrument, into two or even four parts, each produces a plant-bud. Seeing this, it is reasonable to infer that prothallia have the power of producing plant-buds analogous to the leaves of *Begonias* and other plants; but whether such is the case, or each bud is the result of the action of spermatozoids upon latent archegonia, is not known."

To those who are in haste to cultivate ferns, either in the greenhouse, fernery, or out of doors,

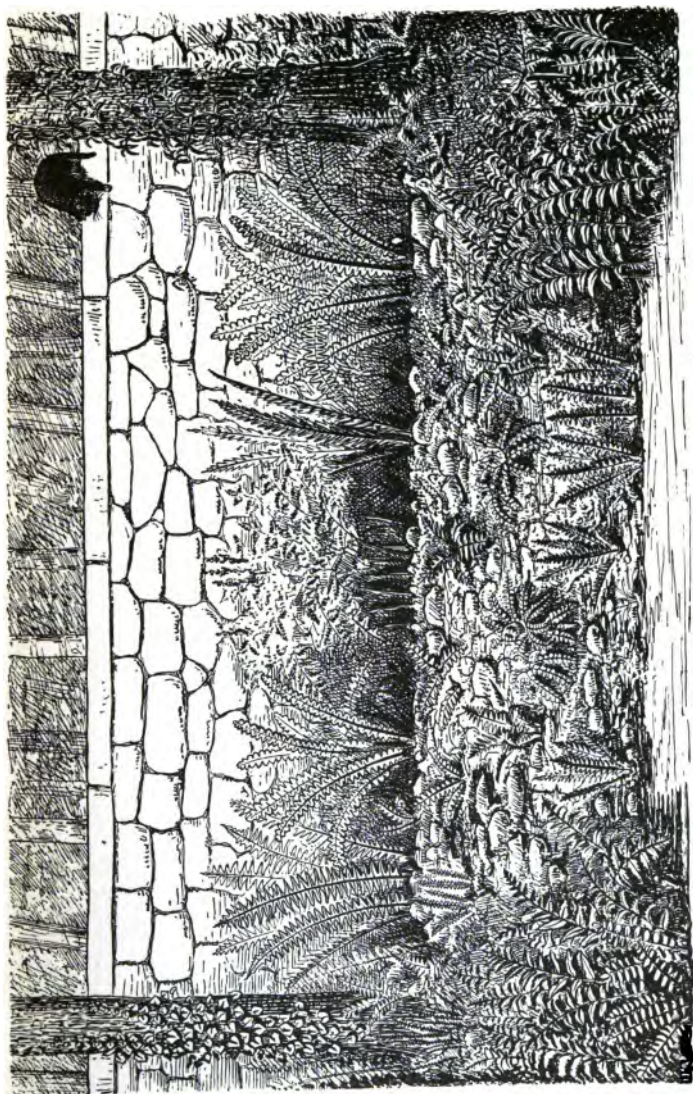


PLATE I. FERNERY OUT OF DOORS.

11

it may seem like dry work to linger in a careful study of their structure, growth, or habits. But to do good work in any thing, it is, as a rule, better to be well grounded at the outset in the fundamental principles of the subject. The cultivation of ferns is no exception to this statement. In order to know the proper size and shape of pan into which a fern should be placed, it is quite important to understand the habit of the plant, — whether the roots are inclined to strike deeply into the ground from an erect stem, as in *Lomaria gibba*, or to spread laterally from a much-forked rhizome below the surface, as in *Pteris aquilina*, or to only penetrate slightly into the soil from a rhizome creeping over the surface. So let us consider the various parts of the fern as it grows.

If a healthy specimen of one of the Maiden-hair ferns, growing in a pot, be inverted and carefully slipped out, it will be noticed, that, at the end of each of the little black, wire-like roots, there will be a portion, some two millimetres in length, which is light in color; indeed, almost white. The extreme tip of this appears brownish if examined with a pocket lens. An enlarged view of a section through the centre of a root-tip will be found Pl. 5, Fig. 11; and it will be seen that the browner portion, *a*, at the extremity, is composed of closer and tougher cells than the rest. It is, in fact, a cap; which, like the bark of a tree, grows and

increases from within, and is continually worn away on the outside as it is pushed ahead by the lengthening of the root. The lightest portion of the figure marked *bc* represents the true root; and the longitudinal growth takes place between the points *b* and *c*, this portion being the only part of the root capable of absorbing much nourishment. This absorption occurs through the outer cells and root-hairs. The darker parts of the roots do not continue to lengthen,—a fact obvious after a moment's thought; as, if they did, the whole mass of roots would become tangled and knotted, and healthy circulation made impossible for the matter which is absorbed at the tips. Now, it will be seen how injurious it must be to roughly tear up, or pull to pieces, the mass of roots, when we are removing or transplanting ferns. These remarks may be applied as well to other plants; for it can be understood that if the only living portion of the root, so to speak, be torn off, the plant is again reduced to the condition of an ordinary fresh cutting, which has again to go through the process of forming roots. The two extreme forms of the stem, or *rhizome*, in ferns, may be illustrated by *Pteris aquilina* (Pl. 5, Fig. 10) and any tree-fern (Pl. 7). The former apparently throws up its fronds here and there separately from some invisible point: the latter regularly unfolds its crown from immediately within the circle of fronds last unfolded.

If we carefully (every thing in the study of ferns must be done with care) dig up, in August, a plant of *Pteris aquilina*, we shall find, that, beyond the base of the fronds perfected the present season (see *a*, in Pl. 5, Fig. 10), there is a short, woolly-covered, rudimentary frond (*b*), which, if nicely dissected, will be found to have the beginning of the portion which is to expand next season closely folded over on its summit. Still farther on, along the underground stem, we shall discover at its extreme end (marked *c*) the rudiment of the frond for the third season, which is not to see the light for two years. At *d* is the continuation of the rhizome: in nature the stem will be more extended than in the figure, as the distances between the fronds will be proportionally greater. If we examine the crown of a tree-fern, or *Aspidium spinulosum*, or *A. marginale*, we shall find circle within circle of little heads, the rudimentary fronds for succeeding years. As the outermost of these develop year by year, fresh ones are formed at the centre to keep up the supply. If we now imagine the tree-fern laid upon its side just beneath the surface of the ground, and its crown turned up at the end so as to allow the fronds to assume an erect position, we shall have something very much like the *Aspidium*, or perhaps more like a *Struthiopteris*. To follow out the comparison still more, it is only

necessary to imagine that the crown, instead of being turned to an erect position, still remains upon its side, and that the fronds only become erect as they develop. We shall then have a plant of the character of *Asplenium filix-fœmina*, or *Woodwardia Virginica*; and, to connect these ferns with the extreme form of the *Pteris*, it will be only necessary to suppose the loose crown of the *Woodwardia* so elongated that only one frond will be found to every inch of stem, and the terminal point of growth to keep at a given distance below the surface of the ground. The importance of observation and the possession of knowledge upon these subjects is very great; as will be found when ferns are to be collected in the woods or fields for transplanting, or specimens are to be chosen from the greenhouse for the fernery, or especially when the species for basket culture are to be selected.

The leaves or fronds of ferns vary greatly in texture and cutting. Familiarity with their texture will greatly aid the cultivator in determining the situation in which a new-comer must be placed when its proper natural surroundings are not already known. If a bit of the under cuticle of a frond be examined by the microscope with a power of fifty to one hundred diameters, the *stomata* or breathing-pores will be seen. They are the same as upon the leaves of flowering plants, and

according to their greater or less number will the fern require a moister or dryer atmosphere. Should the air of the fern-house or case become too dry, and the plant be insufficiently watered, the evaporation of water from the stomata will exceed the supply from the earth, and the fronds will soon become wilted. If a fern of less active habit be placed in too moist an atmosphere, and too profusely watered, it will not endure the wrong condition, but mould and die. Some ferns, however, possess the power of enduring great extremes of moisture and drought. Such is the case with many of our South-western species, where, in the dry season, the fronds curl up, and remain in that condition till again revived in the wet months by the rain. Their roots doubtless penetrate deeply into the crevices of the rocks where the plants grow; and great vitality is retained in the crown from which the fronds spring, and which, like the fronds themselves, is often protected by a dense coat of soft scales. The two species *Cheilanthes lanuginosa* (Pl. 10) and *Notholaena dealbata* (Pl. 2) are examples of this habit.

The writer received from a friend a plant of *Cryptogramme crispa*, which had been collected in California two months before. No pains had been taken to preserve the roots; there was no earth with it; nor had the plant received a drop of water during the entire time which it had spent

in travelling about the country in a trunk. From curiosity, the little crown of this fern was planted; and it was matter of great surprise that in a few weeks it developed several fronds. In cultivation, all ferns of this habit require special treatment.

The frond of a fern represents something more than the ordinary leaf of a plant. Often the merest rudiments only of the leaflets (*pinnae*) are to be found in the young frond just unfolding; while, as the frond unrolls, they develop and grow to their perfect shape. Under favorable circumstances, the frond of some species seems capable of indefinite development, as in *Nephrolepis exaltata*; and, again, there is in some genera (*Gleichenia*, for example) a tendency to a dichotomous (forking) growth, which is often repeated from the same frond during a second season. Another remarkable feature of the fronds of some ferns is the development of viviparous buds, either from the under side, as in *Cystopteris bulbifera*, or above, as in *Asplenium bulbiferum*. In *Cystopteris* these bulblets fall off and grow during the second season; but in most species which have viviparous bulbs they remain attached to the frond, and develop several leaves while still drawing their nourishment from the parent frond. This habit has a parallel in nearly all plants; from the lowest *Algæ* to the highest *Phanerogams*. It might be

illustrated by the *Zoöspores* or swarm-spores of the lower *Algæ*, as in *Conferva*, the common green scum seen in stagnant water; or the *tetraspores* of the *Florideæ*, seaweeds of a higher grade. The *gemmae* of the *Hepaticæ* and Mosses represent the same thing: in these the little seed-like buds are scattered, and reproduce the species which bore them, without any fertilization whatever. The *Lycopodiums* supply instances of this same phenomenon, and it is of quite common occurrence among flowering plants. Illustrations are found in *Begonia* and *Bryophyllum*, and particularly in the familiar bulblets of the Tiger-Lily, which are found at the base of each leaf, and are to be considered as detached axillary buds condensed in form as they are separated from the plant.

A farinaceous substance, white or yellow, is sometimes developed on the under side of some ferns, and, in one or two varieties, on the other side also. It is often thick enough to cover and hide the fruit. This gives the popular names "Gold" and "Silver" ferns to such species. It occurs most frequently with *Gymnogramme* and *Notholaena* (see Pl. 2). Occasionally upon the same plant of *G. calomelanos* will be found some fronds with white, and others with yellow farina. All plants of this habit should be carefully kept out of the way of dripping water, and should not

be syringed, as this will destroy their beautiful appearance.

We now come to consider the fruit, which brings us around to the point from which we started. The spore-cases, as we have seen, vary in size and shape; but in all instances they arise from the outer layer of cells of the frond upon which they are borne. They hence represent what Sachs calls *trichomes* (hairs), being developed in the same manner from the external layer of cells as are the hairs on the root, stem, leaves, &c., of plants. If a careful examination be made, with the aid of a pocket lens, of a collection of spore-cases on the back of a frond, there will frequently be found among them some which have not developed, and are still only hairs, sometimes jointed and club-shaped at the end. The condition of the frond on which the fruit is borne being changed from that of the sterile one, it would naturally result that the development of leaf-tissue would be sacrificed to produce the vast quantity of *sori* which most ferns have; and accordingly we find that the fertile fronds are usually distinguishable from the sterile ones, as being more contracted. To such an extent is this contraction carried, that we finally see the entire leafy portion disappear, and the fertile frond consist of a mass of spore-cases, connected and held together by the veins of the frond only, as in *Osmunda*; or by the small-

PLATE II.



NOTHOLÆNA DEALBATA, KUNZE.

70

est amount of tissue possible, as in the *Onoclea*. Among plants of *Osmunda cinnamomea* a curious form is often found, where portions of the fertile frond have developed sterile leaflets (*pinnae*), resembling somewhat *O. Claytoniana* in appearance, and showing that the fertile is but a *differentiated* sterile frond.





CHAPTER II.

CLASSIFICATION OF FERNS.

IN order that we may better understand the position occupied by the ferns in the classification of the vegetable kingdom, let us examine the table which precedes this chapter, and in which the groups, classes, and orders will be found carried out in the several columns. The arrangement is taken chiefly from Sachs' invaluable work, "A Text-Book of Botany." The lowest vegetable forms are at the bottom of the page; and, as we ascend, we reach the higher ones. The column at the left contains the great groups, *Phanerogams*, *Vascular Cryptogams*, &c.; that is, the plants contained in these groups have sufficient differences to make it proper to arrange them in this manner. For instance, we can say that all *Thallophytes* possess characters which relate them to each other; while none of them have woody bundles, a character which distinguishes *Vascular Cryptogams* from the groups below them, and is com-

mon to all the divisions of *Vascular Cryptogams*. Again: it will be seen that there are differences between the *Cryptogams* themselves (the four lower groups), as great as the differences between *Cryptogams* and *Phanerogams*: i.e., a toadstool (one of the *Thallophytes*) is as much below a *Polypodium* as the *Polypodium* is below a sunflower (one of the *Phanerogams*).

In the second column we find the various classes into which the groups are divided. About midway in this column we find the ferns (*Filices*) as a division of the *Vascular Cryptogams*. It will be noticed that with the ferns, under the heading *Isosporous*, are the *Equisetaceæ* and *Ophioglossaceæ*. This signifies that these three clusters of plants produce but one sort of spores; which fact distinguishes them from the *Lycopodiaceæ* and *Rhizocarpeæ*, which produce two sorts, male and female, and are denominated *Heterosporous*. The *Lycopods* and *Rhizocarps* are thus more like the *Phanerogams* or flowering plants, which have pollen, the male, and an ovule, the female, element. Again: the ferns have upon their leaves *stomata* (breathing-pores), as do the flowering plants: hence they must be placed in advance of the mosses and *Fungi*, as these latter never have such organs. Between the *Characeæ* and *Fungi* will be found in brackets the *Myxomycetes*. These are plants having somewhat the character of *Fungi*, which flour-

ish upon old rotten logs, tan, &c. They have a peculiar jelly-like form, and are capable of slow motion, absorbing their nourishment, as they proceed, from the substance on which they live. They are not yet well enough understood to be definitely placed in the system of classification. Passing to the *Fungi* and *Algæ*, we observe that these are two classes of plants possessing certain parallel characters of development: thus the lower *Algæ* have certain characters in common with the lower *Fungi*; while the higher *Fungi* and *Algæ*, though vastly more developed than the lower ones, have similar features, each to each. This relates particularly to their methods of producing fruit. It has therefore been proposed that they should be considered to be two groups, parallel and equally advanced, called the colored (*Algæ*) and the colorless (*Fungi*). This brings us to the *Lichens*, which unite the last two groups in their organization.

The *Lichens* are now considered by the most eminent botanists to belong rather to the *Fungi* than to any other class. Their nature is thus stated by Sachs: "There can no longer be any doubt that the lichens are true fungi, but distinguished by a singular parasitism. Their hosts are algæ, which grow normally in damp places, but not actually in water. The fungi (the lichen-forming fungi) themselves are not found in any other form than as parasites on algæ; while the algæ which are at-

tacked by them are known in the free condition without the fungus." Nothing more than this clear statement is needed to explain the position of these plants.

As most books now in use pass hastily over the *Ophioglossaceæ*, and place them at the end of the list of ferns, it may be well to ask what are the differences between this order and the true ferns. They are placed in a division by themselves, as equal in value to the ferns, and in some directions are more highly developed than the *Equisetaceæ*, which follow them in the list. First, the *Equisetaceæ* and *Ophioglossaceæ* all have their mode of *vernation* identical with that of *Phanerogams*; i.e., they all come up *straight* from the ground; while all ferns are *circinate*, or unroll from the base upward. Again: the fruit of the *Ophioglossaceæ* arises from the transformation of leaf-tissue; while in the ferns it is an outgrowth from the leaf. Other characters of root, bud, and mode of reproduction, which need only this allusion here, combine with those described to show that the *Ophioglossaceæ* are in advance of the *Equisetaceæ* and the ferns.

Glancing at the third column in the table, it may be noted, that of the *Vascular Cryptogams*, *Muscineæ* and *Characeæ*, the principal genera are given; while among the *Phanerogams* and *Thallophytes* only enough examples are given to enable the reader to understand the divisions. We have

sufficiently discussed the arrangement to see that ferns belong to the *isosporous* division of the group of *Vascular Cryptogams*. They have, therefore, but one spore, and possess woody bundles in their tissue. And, as we have examined the growth of a fern in Chapter I., we have also discovered that ferns have a visible alternation of generations, as it is called. This means that they are not directly produced from the seed as are flowering plants, but their fertilization takes place by means of free moving bodies (antherozoids) upon minute shield-like structures (prothalli), which were themselves developed directly from the spore, without any fertilization having taken place.

We now come to look more closely at the ferns themselves. The class *Filices* is divided into orders, genera, and species. This suggests a profound question, which has puzzled wiser heads than will ever trouble themselves to read this book, and one which has been discussed by Darwin, Huxley, and almost every eminent scientist in the world: What is a *species*? As it is the unit by which we count in studying any classification, we need to understand it as clearly as possible. Smith, in his "Historia Filicum," London, 1875, says, "The difficulty of defining a species becomes evident on taking a view of the numerous forms which connect one species with another. It will be found beyond human power to ascertain

whether the several gradations of allied forms are descendants of primitive specific creations, or are, according to the Darwinian theory of the 'origin of species,' only derivations from primordial creations endowed with a protean principle which becomes manifest during the lapse of ages, and controlled by the different climatic and local influences under which the progeny of the original have become established, and which now form the flora of the earth."

The definition given of a species, "a collection of individuals identical one with another, and capable of reproducing their like from age to age," is quite in contrast with what has just been quoted. Therefore, when we find that "doctors disagree," it does not require much courage to say of a species that it is to be treated as genera, orders, and classes have long been, and is what we choose to make it; and also that the best way to decide upon the merits of any one case is to accept the judgment of the most eminent authors who may have given special study to its forms as to what the limits of the species shall be. Let us therefore, for convenience' sake, consider that a species is a collection of individuals varying but slightly one from another, and capable of producing their like; and that the limits of the species shall be according to the best judgment of those having the advantage of the most specimens for compari-

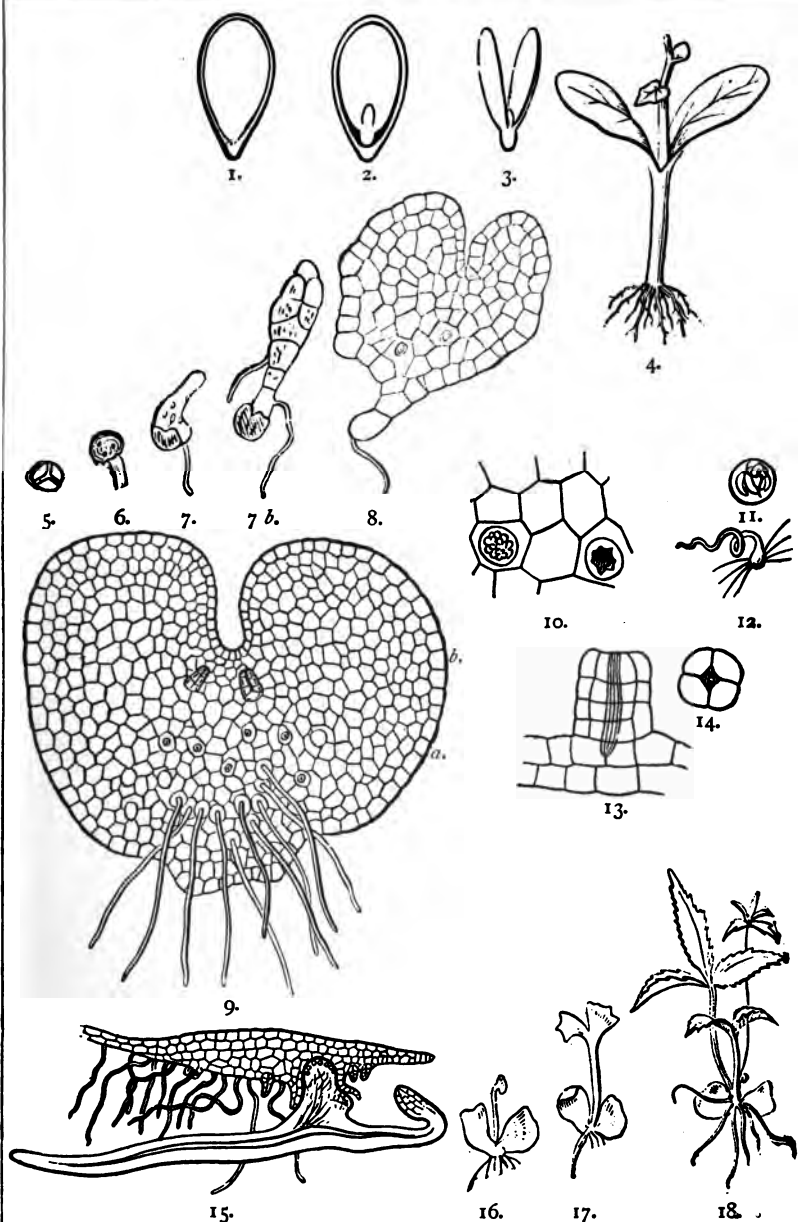
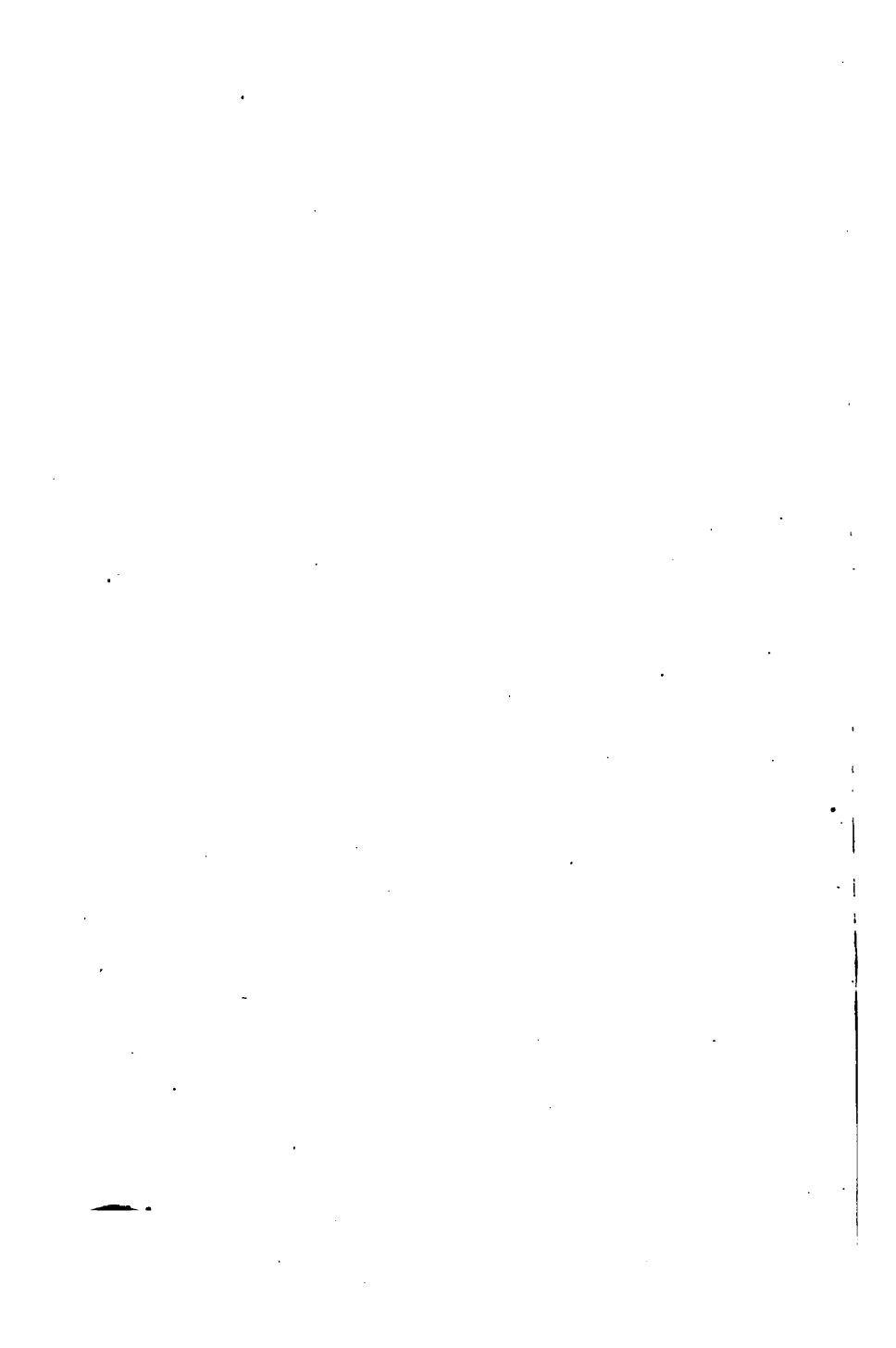


PLATE III. FERN GROWTH.



son; and, lastly, that it is as yet but a group of individuals placed together for convenience in arranging a systematic classification of the whole.

Taking an average among authors, we may say that there are 2,500 species of ferns. Hooker's "Synopsis Filicum," in its first edition, gives 2,228 species: in the second, by Baker in 1874, there are mentioned 2,646. Linnæus knew but 190 species.

These species are united, according to various authors, into genera, which number from eleven to two hundred and thirty, as follows:—

Linnaeus	11
Presl	230
Fée (1852)	181
Moore (1857)	178
Hooker and Baker (1874)	76
J. Smith (1875)	220

There is much to be said against multiplying species; but it is certainly fair to admit with Smith that it is easier to remember six or eight genera, each containing fifty species, than to carry in the mind the four hundred and forty-eight species of *Polypodium* as given by Hooker and Baker in 1874. The various genera are constructed upon the different modes of fruiting, and the position of the fruit upon the frond: as, for instance, whether or not there be a covering (*indusium*) to protect the spore-cases; whether the fruit be at the middle

or termination of a vein, &c. These genera are again united into orders, based upon the form of the spore-case and the position of the ring of cells which is found upon most sporangia. Hooker ("Synopsis Filicum"), the authority most frequently quoted, has five orders, or sub-orders, as, according to his mode of dividing, they become. Aside from the *Ophioglossums*, they run thus : —

(Ring horizontal)	I. Gleicheniaceæ (2 gen., 24 sp.)
(Ring vertical)	II. Polypodiaceæ (13 tribes) (59 gen., 2,098 sp.)
(Ring at one side)	III. Osmundaceæ (2 gen., 10 sp.)
(Ring apical)	IV. Schizæaceæ (5 gen., 60 sp.)
(No ring)	V. Marattiaceæ (4 gen., 20 sp.)

This very unequal division gives the *Polypodiaceæ* five-sixths of all the genera and twenty-six twenty-sevenths of all the species. Hooker and Baker also divide the genera into tribes, and in the large genera distribute the species among sections or sub-genera.

Smith, in the "Historia Filicum," divides the ferns thus : I. *Eremobria*, those ferns whose fronds are articulated along a creeping stem, and break off, leaving a scar, like the leaves of deciduous trees in autumn (example, *Polypodium*) ; II. *Desmobria*, ferns whose fronds remain attached, and are produced from a crown (*Aspidium*) ; and, III. *Scaphobrya*, fronds terminal, rising from between two appendages, and articulated with the caudex (*Marattia*). Those sections he then subdivides into

twenty-nine tribes, arranged according to natural characteristics, and broken up into two hundred and twenty genera. Although this arrangement is very little in use, the division of species in it is much more equal and less artificial than the other system, and is to be strongly commended. Mr. Smith's long service at Kew Gardens, where he had under his care and constant observation sometimes a thousand species of ferns, and where he had the use of the largest herbarium of ferns in the world, gives his opinion great weight.

Sachs, complaining of the artificial manner in which the *Filices* are divided by various authors, proposes a classification in which the *Hymenophyllaceæ* (Filmy Ferns and Bristle Ferns) shall be placed at the bottom, instead of the middle of the list as with most authors, because these are ferns peculiar for their small size and thin fronds, and are more nearly related to the mosses than are other ferns. His orders are, —

- | | |
|---------------------|------------------|
| 1. Hymenophyllaceæ. | 4. Osmundaceæ. |
| 2. Gleicheniaceæ. | 5. Cyatheaceæ. |
| 3. Schizæaceæ. | 6. Polypodiaceæ. |

Marattiaceæ, included in Hooker's classification, he says should, on account of the formation of its fruit, be placed beside the *Equisetaceæ* and the *Ophioglossaceæ*.

We have now learned what place ferns occupy in a general classification of plants, and how they

are themselves divided into species. Now, the species are again divided into varieties. Where there does not seem to be sufficient reason to make a separate species for it, the new fern to be described is placed as a variety of some already existing species. Here authors differ as much as anywhere else. For instance, Hooker, in "Synopsis Filicum," unites under *Ophioglossum nudicaule* six species of other authors, he considering them varieties only. Besides the ordinary varieties found in nature, the desire for new ferns has given rise to an enormous number of cultivated or garden varieties. These are "sports" from plants, carefully preserved and perpetuated by nurserymen and gardeners. A few among these are perhaps beautiful or curious; but the great majority are horrible deformities of the original species from which they started, and serve no useful purpose whatever, except perhaps to prove how much a species may be made to vary in a short time, and to compare this with what might be done in one of the earth's great periods. The writer has before him the catalogue of a dealer who advertises fifty-one varieties of *Asplenium Filix-femina*! Cooke, in his little book, "A Fern Book for Everybody," remarks that some painstaking people have hunted up and described eighty-five varieties of *Scolopendrium vulgare*,—"love's labor lost," or at least fearfully wasted.

Some of these cultivated varieties are so different from their progenitors, that even the *genus* to which they are supposed to belong is with difficulty suspected. It is as if we were to encourage and produce a quantity of malformed dogs and cats, or children it may be, and revel in their hideous shapes and disguised forms. The writer may be influenced by prejudice against this sort of culture; but it seems to him like trifling with the good and beautiful gifts which Nature has bestowed.

There may be hybrids among ferns. *Asplenium ebenoides* is supposed by some authors to be one. If it is, it is the result of the prothallus of one species being fertilized by the antherozoids of another species, or even genus. This is not impossible; as it is shown that sometimes a prothallus cannot be fertilized within itself, and therefore it must be that the antherozoids reach it from another. Should they come from the prothallus of another species, a hybrid would be the consequence; if from that of the same species, it would be an example of cross-fertilization only, and interesting to Mr. Darwin.

If this chapter has not produced utter confusion in the reader's mind, it may have sufficiently indicated the confusion and discord in botanical classification; so that it may be understood that the name of a fern, as indicating its rank and place, is

not the work of a superior intelligence, but only the imperfect work of man to aid him in his endeavors to classify the productions of nature in the most natural way. Here we are led to speak of what is called *synonymy*. It is evident, that as authors differ in their arrangement and names of species, genera, orders, &c., so they differ in the names applied to the same ferns. If several botanists obtain and describe the same fern, independently of each other, each will give it a different name, and these names will be called *synonymes*. This has been done for so long and so often, that we sometimes have a dozen names for the same fern. A good illustration of this point may be found in Eaton's "Ferns of North America," Part II., where *Polypodium lanosum*, *Acrostichum hispidum*, *Adiantum vestitum*, *Aspidium lanosum*, &c., are mentioned as having been given from time to time, by different authors, to our common *Cheilanthes vestita*. Taking into consideration the various ways in which the names and position of a species may be changed, and the various places in which it may be found in the books which he consults, it is no wonder that the young botanist is frequently confused and discouraged.





CHAPTER III.

DISTRIBUTION AND NOMENCLATURE OF FERNS.

AT page 128 of Dana's "Manual of Geology" is a very simple diagram, which well illustrates the antiquity, development, and comparative abundance of ferns in the geologic periods of the earth. As that will teach us, ferns are first found in the Devonian, or Age of Fishes. Their number increases rapidly from that time, until, in the Carboniferous Period, they reach their highest point in structure, quantity, and size. In the epochs which follow they are slowly reduced in number, until the Age of Man, when we find them as they are now, with no apparent change since prehistoric days. From what this record shows us, we are led to look at the conditions under which ferns attained their greatest perfection. According to Dana, these were "a moist, warm climate," with "less sunshine," since there "was a very much larger evaporation than now;" "a climate insular throughout," with

"fewer storms than at present," and "a less rapid movement of general circulation," with "an excess of carbonic acid in the atmosphere." Now, this is just the climate which we seek to create in our hot-houses, except that we do not increase the usual percentage of carbonic acid. If we look over the earth for the nearest approach to the climate of the Carboniferous Period which Nature at present exhibits, we discover it on some of the tropical islands ; and here, as might be expected, are the finest ferns, and in the greatest variety.

Smith gives the following numbers of species for different localities :—

ISLANDS.

Ceylon	214 species.
Mauritius	235 "
Java	460 "
Philippines	297 "
Fiji	185 "
British West Indies	340 "

MAIN LAND WITH SIMILAR CLIMATE.

Brazil	387 species.
Parts of India	319 "
Isthmus of Panama	117 "
Tropical America	946 "

Contrast with these —

North America, north of Mexico	150 species.
All Europe	67 "
Asia Minor and Syria	25 "
Arctic Zone	26 "

PLATE IV.



PELLÆA Densa, Hook.

2

20

The Tree-Ferns are all found in tropical or sub-tropical countries.

It is difficult to ascertain exactly how the ferns of the various countries of the globe compare in quantity with the other plants of the same districts; but it is safe to say that the proportion of ferns in quantity is larger as the proportion in number of species increases. The following gives some idea of the ratio of the number of species of ferns to that of flowering plants:—

Jamaica . . .	1 fern to 8 flowering plants.		
New Guinea . .	" 4	"	"
Tropical America .	" 35	"	"
Portugal . . .	" 105	"	"
Greece . . .	" 227	"	"
U. S., east of the Mississippi . .	" 46	"	"

The great majority of ferns are perennial. Only a few are annual; *Gymnogramme leptophylla*, *G. chærophylla*, and *Ceratopteris thalictroides* being examples. The latter is also *aquatic*,—almost the only fern that is so,—for it grows in shallow water, with the sterile fronds floating on the surface of the stream.

Many ferns, instead of growing in the earth in the usual way, force their roots deeply into the crevices of rocks; as, *Notholaena* (Pl. 2), *Pellaea* (Pl. 4), &c. Still others, as *Vittaria* and *Nephrolepis*, are epiphytic, growing upon trees,

although they receive no nourishment from this source. In England, and some parts of this country, the common *Polypodium* has the same habit; but in the Eastern United States the moisture of the atmosphere is insufficient to enable it to do so.

Ferns vary in size, from the smallest species of *Trichomanes* to the huge Tree-Ferns. A fruited plant of *Trichomanes Petersii*, of Alabama, may be covered, roots and all, with a silver dime; while the Tree-Ferns sometimes reach the enormous height of eighty feet, and bear fronds twenty-five feet in length.

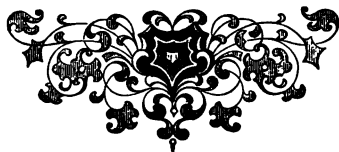
As regards the practical uses of ferns, not much can be said. Their great value is in the share of work they do in Nature's laboratory of air and earth. A few are used in a medicinal way. In some countries the young fronds are cooked and eaten like asparagus, and in Nepaul the natives employ the tubers of a *Nephrolepis* as an article of food. *Adiantum pedatum*, the common Maidenhair, has the honor to serve as a Shaker herb. This matter, however, including the superstitious uses of ferns by people of civilized as well as barbarous lands, we shall pass by with this simple mention, as it is with their æsthetic value that we have to do.

The names of ferns (their nomenclature, as it is called) sometimes give considerable trouble to

those selecting species for cultivation. All catalogues and books do not give the same name to the same fern. Some authors use Hooker's names, some Moore's or Smith's, and so on. This is an unfortunate practice, and causes frequent mistakes. Then, again, the same name has been unintentionally used by different botanists to describe quite different ferns: so it becomes necessary to use the name of the person who described each species, to distinguish it with certainty from others. Thus the *Polypodium auriculatum* of Linnæus is our *Asplenium ebeneum* of Aiton, a little fern; while the *Polypodium auriculatum* of Wallich is a true *Polypodium*, with fronds four feet long and a foot broad. This illustrates how important it is, in speaking of ferns, to mention the name of the describer as well as that of the species.

The generic names of ferns are principally made by a combination of two Greek words, often proper names, with a Latin termination. Some are derived from mythological characters, local aboriginal titles, &c.; while there are a number of unknown origin and unintelligible application. *Pteris* (from *pteron* = wing) is found in combination with other words in many names of ferns. It was originally applied to the *Bracken*: and, as this is one of the most common of ferns, it has come to be used to signify ferns in general; as *Struthiopteris* (*struthios* = ostrich), the Ostrich

Fern. The following are generic names of ferns: *Woodsia*, from Joseph Woods, an English botanist who died in 1864; and *Osmunda*, from Osmunder, a Celtic divinity (one of the names of Thor). The specific names are commonly adjectives agreeing with the generic ones, sometimes derived from the name of the discoverer of the fern, as *Polypodium Scouleri*; sometimes from the country or locality in which the plant grows, as *Woodwardia Virginica*; or some character of the fern, as *Polypodium aureum* (golden); or, again, it may be an old substantive name, and need not agree with the generic one, as *Asplenium Trichomanes*. Almost any text-book will enable the reader to fill in this outline of nomenclature; but he must remember that all botanists have not been classical scholars, and hence there are many irregularities and discrepancies to be found among the names of ferns.





CHAPTER IV.

SOMETHING OF THE LITERATURE OF FERNS.

TP to 1877, no work upon the ferns, either of a scientific or popular nature, had been published in North America. There were only a few magazine articles, short papers in the transactions of scientific societies, with here and there a page or two in the Government Exploring Expedition Reports; while our botanies contained only the ferns growing east of the Mississippi. In the various European books on ferns, there are many illustrations of North-American species; but it is necessary to consult a large number of volumes in order to find them all. The greatest number of American species will be found in the works of Sir W. J. and Sir Joseph D. Hooker. Lowe's books on ferns contain many, but the illustrations are not of the highest order. The want of an American treatise on this subject is now being supplied in the most satisfactory manner by the publication by Mr. Cassino of a finely-illus-

trated work in large quarto form, where every species and the principal varieties of North-American ferns are to be represented by colored plates drawn from the plants themselves by Mr. Emerton. The text, as prepared by Professor Eaton, who stands in this country at the head of pteridologists, at once raises this work above the level of a mere picture-book; where, in less careful hands, publications of this class are apt to remain. The fact that but about 150 species are to be represented renders it possible to make an end as well as a beginning to the book: so that with twenty-five parts, containing three plates each, it is possible to give it complete to the public; while, with a general work on plants, these limits must be indefinitely exceeded. The five parts, with illustrations of thirty species, already issued, have surpassed the expectations of all; and, by Professor Eaton's valuable descriptions, the work is placed in the first rank.

Besides this, a more modest book, in octavo, on the ferns of Kentucky, is nearly ready for publication. It is to be illustrated by etchings of each species, made by the author, Mr. Williamson. It will be an excellent work, and deserves a wide circulation. Two check-lists of North-American ferns have appeared at different times: one by Mr. William Edwards, on a single sheet, intended only as an exchange list; the other, of 12 pages

8vo, printed on one side only, and intended for labelling specimens, as well as a list for purposes of exchange. The latter was prepared under the advice of Professor Eaton.

The following works are interesting as containing references to American species :—

ICONES FILICUM: by Sir W. J. Hooker. London, 1831. Folio. Contains descriptions and plates of 12 species of ferns, one *Ophioglossum*, and one *Lycopodium* of North America. This work costs from \$25 to \$75, according to the colored or uncolored condition of the plates.

FILICES EXOTICÆ: by Sir W. J. Hooker. London, 1859. Large 4to. Descriptions and plates of 7 North-American ferns, and one *Lycopodium*. Costs about \$20.

GARDEN FERNS: by Sir W. J. Hooker. London, 1862. 8vo. Contains 4 North-American ferns. Costs about \$8.

CENTURY OF FERNS: by Sir W. J. Hooker. London, 1854. Large 8vo. Contains 3 species of North-American ferns. Costs about \$10.

SECOND CENTURY OF FERNS: by Sir W. J. Hooker. London, 1861. Large 8vo. Contains 2 North-American ferns. Costs about \$10.

SPECIES FILICUM: by Sir W. J. Hooker. London, 1846-64. 5 vols. 8vo. Vol. ii. contains 17 and vol. iii. contains 2 plates of American ferns, and descriptions of a greater number than this of species. Costs from \$40 to \$60.

SYNOPSIS FILICUM: by Sir W. J. Hooker and J. G. Baker. 2d ed. London, 1874. 8vo. Contains a short description of all known ferns, including, of course, the American species. There is also a figure illustrating the characteristics of each genus. It costs \$9.

GENERA FILICUM: by Sir W. J. Hooker. Plates by Francis Bauer. Large 8vo. London, 1842. Contains magnificent plates illustrating the characters of 135 genera of different authors, including all the American genera. This work can be purchased for about \$25.

Hooker's **EXOTIC FLORA** and his **ICONES PLANTARUM** also contain many plates of ferns.

FERNS OF SOUTHERN INDIA, and FERNS OF BRITISH INDIA, by R. H. Beddome (Madras, India, 1868-73, 4to), contains altogether 616 full-page admirable plates in outline of Indian ferns, with description of each species. A rare and valuable work, probably costing at least \$50.

FERNS, BRITISH AND FOREIGN: by E. J. Lowe. London, 1868. 9 vols. 8vo. 550 plates. The ninth volume is called **NEW AND RARE FERNS**. This is a singular work. The plates vary much in quality: some are very poor. A great many American ferns are represented here in better or worse shape; but the descriptions are worthless, and the synonymy is often incorrect.

As there are in Great Britain about 16 species



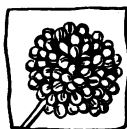
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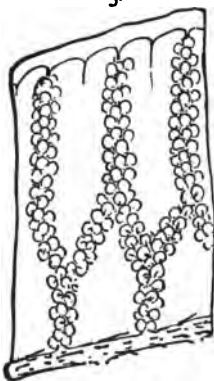
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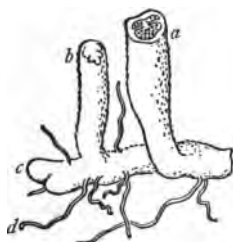
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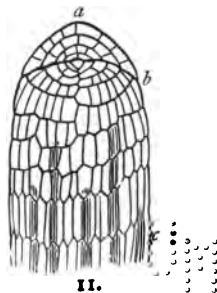
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PLATE V. FERN STRUCTURE.



of ferns in common with North America, we can consult some of the local works on British ferns with profit. The best of these is Hooker's *BRITISH FERNS*; another excellent one is *THE FERNS OF GREAT BRITAIN, AND THEIR ALLIES*, by Sowerby and Johnson. The latter is almost the only work which gives plates of the *Characeæ*. They are both rather costly books.

Moore's *NATURE-PRINTED BRITISH FERNS* is published in two forms, folio and 8vo. The 8vo edition forms two volumes of a series which includes *Algæ*, &c. The folio edition costs about \$35.

Among the cheapest of all books on ferns is *A FERN-BOOK FOR EVERYBODY*, by M. C. Cooke; a small 12mo, with colored plates and 124 pages of text. Very like this book also is *BRITISH FERNS*, by Thomas Moore. These books sell in England for a shilling: by the time they reach us, their price is seventy-five cents; but that is cheap enough for the amount of valuable information contained within their paper covers. Besides the books here mentioned, the English press has issued many volumes on ferns, high and low priced, of which some of the earlier ones are especially good even now, while many of the later are crude and hastily written, having apparently been produced at the sudden demand of a fancy or a market.

The works so far considered relate to the system-

atic arrangement of the ferns, and description of their species, and are valuable for our purpose so far as they deal with American ones. For the structure or morphology of ferns we can confine ourselves to works written or translated into languages which all can read. Our school and college botanies contain but a small amount of information about ferns. To learn their structure and development we must refer to more elaborate treatises, especially to the writings of foreign authors; and we shall do well to study the development of other plants also, that we may have correct ideas of the analogies of ferns with the rest of the vegetable world.

Among these books of wider range is the admirable TEXT-BOOK OF STRUCTURAL AND PHYSIOLOGICAL BOTANY, by Otto W. Thomé, translated by A. W. Bennett; illustrated by 600 cuts, and map. The American edition is published by John Wiley and Sons, New York, 1877. The ideas in the book are modern, and more space in proportion to its size is given to the *Cryptogams* than in almost any treatise on the subject. This book costs \$2.50, and is intended as a text-book for schools.

A GENERAL SYSTEM OF BOTANY, by Le Maout and Decaisne, translated by Mrs. Hooker, London, 1873, 1066 pp. 4to, may also be mentioned here. This valuable reference-book devotes nearly 100 pages to the *Cryptogams*, and the subject is illus-

trated by many very excellent figures. Owing to its size, the work is rather expensive; costing from \$15 to \$30, according to paper and binding.

FERNS, BRITISH AND FOREIGN, by John Smith (London, 1866, 8vo, pp. 412), under the head "Cultivation," contains much valuable information on fern-structure. There is also much of interest regarding the introduction of foreign species into England.

HISTORIA FILICUM (London, Macmillan & Co., 1875, 8vo, 429 pp.), by the same author, an curator of Kew Gardens, contains a great deal of original matter relating to the modes of fern-growth. The introductory and closing chapters are of especial interest, and several quotations from them will be found in the present volume. The bulk of the book is an exposition of the author's plan of classifying ferns, and a review of the plans adopted by others. It is copiously illustrated; and the price in this country is high, being \$6.

But undoubtedly the best book given to botanists for many years is the TEXT-BOOK OF BOTANY, MORPHOLOGICAL AND PHYSIOLOGICAL, by Julius Sachs, translated by A. W. Bennett and W. T. Thistleton Dyer; London, Macmillan & Co.; 858 pp. large 8vo. In this work, under the head "Book II., Special Morphology, and Outlines of Classification," there are 380 pages, of which 30

are devoted to the ferns out of the 214 devoted to *Cryptogams*. Besides this there are many other references to ferns in the chapters on General Morphology and Physiology. In the preface it is stated, "This text-book is intended to introduce the student to the present state of our knowledge of botanical science." And again: "In the references which will be found in this work, the chief object has been to introduce the student to those writings in which he will find a full discussion of the subjects which have only been touched on briefly. . . . The reader of this work will at least learn the names and standing of those workers who have in recent times contributed most essentially to the science of which it treats." In the translator's preface is this: "The translator believes that he is supplying a want that has long been felt by English botanical students. Our own literature has not at present produced any work at once so comprehensive in its scope, and so minute and so accurate in its details, — qualities which have recommended the German work to every one familiar with that language." This book is illustrated by 461 figures, chiefly the result of difficult microscopic analysis. It may be found in many libraries, and to the student is simply invaluable. The price in this country is \$9.

ON THE DEVELOPMENT AND FRUCTIFICATION
OF THE HIGHER CRYPTOGAMIA, AND ON THE FRUC-

TIFICATION OF THE CONIFERÆ, by Dr. William Hoffmeister ; translated by Frederic Currey ; published by the Ray Society, London, 1862 ; pp. 506 ; 65 plates. The original price was £1. 5s. 6d., and it is now difficult to obtain a copy. The plates are all made from microscopic studies, and are finely executed. It is valuable for careful study and comparison ; but it is found in few libraries.

Among other authors worth consulting, but whose works have not yet been translated into English, are Mettenius, Milde, Fée, and Presl.

Besides the books above mentioned, there are many devoted either to the general cultivation of ferns, or to the æsthetic side of fern hunting and cultivation. A few of them allude to the structure and mode of growth of ferns, and, without affecting to go very deeply into the subject, give a correct idea of it as far as they discuss it. Others, not aiming at any scientific character, are charming examples of literary finish. But it is to be regretted that many books of this class, and some of even as late a date as 1867, convey the most erroneous ideas both in regard to the analogies between ferns and other plants, and the methods of reproduction in ferns. Some even leave the reader with the impression that there is no sexual system at all in these plants, or any thing to establish in this a parallel between them and the *Phanerogams*.

No book on fern-cultivation contains in a small space more useful information, divested of all superfluous rhetoric, than *THE FERN GARDEN*, by Shirley Hibberd; London, Groombridge & Sons, 1870; 8vo, pp. 148; with numerous illustrations. The suggestions of this work are of the greatest service to the amateur of limited means; and are, as the writer has proved by personal experience during the last five years, eminently practical. This book costs \$1.75.

In Smith's *FERNS, BRITISH AND FOREIGN*, previously alluded to, there is much of value concerning the cultivation of ferns, especially in the greenhouse.

SELECT FERNS, BRITISH AND EXOTIC, by B. S. Williams (London, published and sold by the author; pp. 330 8vo, illustrated), is a valuable work for those who are intending to cultivate ferns in a greenhouse or stove, particularly if it is their intention to deal extensively with rare and costly species. Mr. Williams's experience in this branch of fern-culture enables him to speak with assurance upon the subject. This book has always been kept on sale by Mr. George Such, the extensive cultivator of orchids and rare plants at South Amboy, N.J., and costs \$2.50.

It would be unjust to close this chapter without reference to the many excellent articles upon ferns and their culture which are scattered over

the pages of the best English and American magazines. But the absence of subject-catalogues renders this literature practically useless. Chance may direct us to what we are looking for ; but, until our principal libraries shall put into practice some index-system which shall give to us control of these writings, many of them will be lost, and they are liable to be unintentionally reproduced by other authors in after-years.





CHAPTER V.

HOW TO COLLECT FERNS FOR CULTIVATION.

THE desire to collect ferns for growing at home is a very natural accompaniment of a winter health-trip to Bermuda or Florida, or our summer vacation at the White Mountains or Ausable Chasm. It becomes a fever in such places as the Yosemite or in Brazil. It is only necessary to see the graceful plants, with their delicate fronds or feathery crowns, to begin dreaming how they would adorn the windows of our sitting-room, or some neglected corner of our garden. But, when we meet them thus in their full beauty, they are in the most unfavorable state for transplanting, as, in the vigor of its growing condition in its natural home, a fern will endure little rough handling, and requires the most tender care to persuade it to become domesticated in any other place. It would, indeed, be better for us to wait till the period of the season's activity had passed, which it is probable that we cannot do;

PLATE VI.



CHEILANTHES COOPERÆ, D. C. EATON.



or collect our ferns in the early spring before the croziers unroll; but, when the plants are in this condition, only an experienced botanizer knows what to look for, and where to find it. Even the most practised of fern-hunters may only chance upon the opportunity of securing some rare species when it is the worst possible time for removing it. Then, too, it is best to indulge the inspiration of the moment; for the enthusiasm may not return until too late for another year also.

Suppose, then, that in July or August, at one of our Northern watering-places, we wish to obtain a small collection of our native ferns in their living state. The best way of transporting them is, of course, with their fronds uncrushed, in a box or basket of sufficient size. But this is not always practicable. It may be necessary to condense them, in packing, into the smallest possible space. As we collect them, the ferns can be kept in a bowl or basket till we are preparing for our journey home. When we gather them, the roots should be carefully dug up, not wrenched from their surroundings; and, when we begin to get them ready for their travels, should not be very wet. Suffer the plants to remain without water a day or two before packing: only do not allow them to become exactly dry. Then we may shake off as much of the earth as will readily fall away, and, wrapping each fern with a bit of damp (not

wet) moss, roll it up in a bit of paper large enough to hold all together, tying the parcel with a thread. The fronds should all project beyond the moss and paper, and only enough of them be left to insure a healthy start for the next season. The proper number of fronds to leave will be three or four on an ordinary, and six on a very large plant. In order to remember how the ferns looked (for we are not yet supposed to be acquainted with their names), it will be a good plan to press a frond of each, and number it, tying a tag with the corresponding number to the collected specimen itself. When this is done, all the packages should be arranged with the fronds lying in the same direction; and a number of fresh fronds should be collected, and placed around the fronds of the ferns to be carried home. Then the whole may be rolled up firmly into a bundle, which should be covered by several thicknesses of stout manila-paper, and tied securely. The package is now ready to place in a trunk among its other contents, to deliver to the expressman, or to be carried under the arm. Unless it is left exposed to the hot sun, or in a very dry place, the ferns in this bundle will not suffer in vitality or health for a fortnight or three weeks.

When at the end of their journey, the ferns must be carefully unwrapped, and firmly planted in the spot chosen for their future home. A

good light soil, whether out of doors or in the fernery, is best. At first, nearly all the fronds will lie quite prostrate on the ground; but if they are frequently sprinkled on both sides, and their roots kept only damp, the plants will establish themselves, and reward the pains bestowed upon them by a fine healthy growth the very next season. In the time intervening, the pressed fronds can be examined and named; and if the numbers tied to each package are marked on little sticks, and placed with the roots, we shall know what our plants are, and what to expect of each root before it grows at all.

Our first surprise the next spring will be, when on some walk we discover large quantities of some fern, which we had spared no pains the summer before to bring from two hundred or five hundred miles away, growing within a mile of our own door. This occurs to every one who begins fern-collecting away from home; but the transplanted specimens, though they lose thus their rarity, remain as perpetual remembrancers of our first delight and interest in them. A lady living not a thousand miles from Boston brought from Vermont a few starved plants of Maidenhair (*Adiantum pedatum*), and showed them to the writer with the greatest satisfaction; but what was her surprise when she learned that within a few rods of her old family home, where she was wont to

spend half her summers, the same Maidenhair grew in luxuriance and perfection, hardly surpassed by examples from any other known locality!

The collecting of ferns at a distance from home must, of course, be confined to the smaller species or small plants of the larger ones. But, if we are in haste to stock an out-of-doors fernery, it is important to obtain larger ferns at once. For this purpose, a covered wagon, a number of shallow boxes, a strong spade, and a hatchet, will be required. Suppose that we have made the acquaintance of all the North-American ferns, and that we have noted some region where fifteen or twenty species may be collected in a trip of reasonable extent. We make our excursion just as the fernfronds are coming up from the ground. The *Aspidiums* will all be found easy to lift, and all we desire of them can be quickly gathered. But with the *Osmundas* the case is different. Our hatchet, or even an axe, will be of great assistance if we wish to collect large plants of this species; for the woody base from which the plants spring is almost as tough as oak. While we may *dig* up the roots on the outside of a tuft of *Osmundas*, it will be necessary to *cut* the growing portion away from the older part. An old mortising-chisel may be of service to us in removing the plants of *Asplenium Trichomanes*, *A. ebeneum*, *Cystopteris fragilis*, and

other species which cling to the rocks, and send their roots deep into the crevices. Great care must be taken not to break the young fronds, which are very tender: so here our boxes come into play, as these may be filled, and safely piled one on another. Many of the ferns for which we are searching are "evergreen" species; i.e., the fronds of one season do not wither till the new ones are well developed. Of course, all these are easily identified. There are in New England a good many of this habit, including the larger *Aspidiums*, *Asplenium ebeneum*, and *Trichomanes*, &c. After filling our wagon, we return without delay to plant our ferns. This would be best done at evening; but we have selected a dull day without sunshine for our trip, and may, with care, proceed at once to the work. The spot on which we have decided to establish our fernery should have been previously prepared, and the plants judiciously distributed in their proper places. The hints for this are elsewhere given.

The collector will soon learn to vary his methods of gathering and preserving ferns to suit the circumstances and the time. The tin botanical case is always useful; and, for a short trip with uncertain prospects, a large newspaper will answer all requirements. Later in the season the ferns may be treated with less delicacy, and may even be thrown promiscuously into a bag or sack.



CHAPTER VI.

FERNERIES OUT OF DOORS.

IT is surprising to how limited an extent our native ferns have been cultivated, even by those who possess the greatest advantages for so doing. Time and money enough have continually been spent on horticultural fancies or fashions. Right-and-left or symmetrical effects have been attempted with evergreens and other shrubs trimmed into spires and domes, where every twig which dared attempt to be graceful was lopped off, and thrown on the brush-heap. Persistent efforts have been made year after year to grow sun-loving plants in the shade, that they might form a screen for some ugly fence or building. Such attempts are failures, as they deserve to be, and as, indeed, all the fantastic tricks of gardening are, when Nature has her way. It may be in place to give the details of an experiment of a different kind, successfully tried by the writer of this little book.

An old division-fence, where, on the other side, the land was two feet higher than our own, had long given much trouble by settling out of line. To remedy this, a rough wall of stone, an abundant material on the spot, was made about two feet in front of the fence, and the space between filled with good loam and leaf-mould well mixed. As the rocks were loosely piled together, the earth found its way among them, filling the wide crevices like so many diminutive pockets. After the fence was re-set, a row of tall ferns, as *Struthiopteris*, *Osmunda*, *Asplenium filix-fœmina*, &c., were planted on the terrace just made, and smaller species were established on its edge at the feet of the larger ones. The pockets were filled with strong plants of *Asplenium Trichomanes*, *A. eburneum*, *Polypodium Phegopteris*, *Polypodium Dryopteris*, and *P. vulgare*. At the base of the wall more of the larger-growing species were planted, including *Aspidium acrostichoides*, *Dicksonia*, and *Adiantum*. At either end of the wall, which was thirty feet in length, the rocks were piled up, and brought farther out into the garden and higher than the others; care being taken to have plenty of earth in the crevices, and also to slope the structure so as to preclude the possibility of the whole falling down after the first season. At one end, on the mound of rocks, grows a small tree of the *Pseudacacia viscosa*, which shades the only sunny

spot ; and at the other is an old peach-tree. Associated with the ferns are *Clintonia*, several species of violets, *Hepatica triloba*, and a splendid clump of *Cypripedium spectabile*. Opposite the terrace, across a gravelled walk, are more ferns, and a number of native plants. Very little care is required to insure a thrifty growth. In fact, the only necessary thing is to sprinkle the whole once a day, in dry weather, from the hose attached to a private hydrant near by. Were not the water-supply so conveniently placed, any of the hand-sprinklers would answer, — even a watering-pot ; the only disadvantage of the latter being the labor required to lift and use it.

There is, of course, no limit to the expensive and beautiful effects which the wealthy cultivator may command. But this little book is not published to furnish a guide to such extensive works in horticulture as are indulged in across the water : it would rather suggest the simpler and less costly methods of cultivating ferns. Another thing must be constantly borne in mind : our climate in North America, especially in New England, the Middle States, and westward, prevents our applying to the out-door culture of ferns the suggestions of many valuable English treatises, which are of service only in the mild insular climate of that favored country. Even the hardiest ferns require here more shade in summer, and



PLATE VII. *DICKSONIA ANTARCTICA*, LABILL.

(From plant six feet high.)

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more protection in winter. Shirley Hibberd, in that delightful book "The Fern Garden," describes his own out-door fernery. It is a beautiful "ruin," built of *burrs* from the brick-yard: its walls are all double, so that the earth may reach down to the ground-line from all the summits and pockets of the structure. Specimens of *Pteris aquilina*, which with us rarely exceed four feet in height, grow about this fernery to ten feet above the soil; and in his "cold" house, "with the occasional help of an oil-stove, every thing is kept safely through the cold snaps till the weather changes." In this house, without heating-apparatus, he succeeds finely with such ferns as *Woodwardia radicans*, *Aspidium falcatum*, *Pteris Cretica* (variety *albo-lineata*), *Davallia Canariensis*, *Adiantum formosum*, *Platyserium alpicorne*, and many others which with us could only be considered inhabitants of the temperate house, which must be heated artificially at least for six months in the year, or the in-doors fernery.

There have been so few attempts with us to cultivate foreign or distant American ferns, that it is difficult to extend the list of ferns for the out-door collection beyond the common species which are enumerated at the close of this chapter. With as many charming native and foreign plants as we shall find available, it would be absurd to confine this collection to ferns. One of the most graceful

plants obtainable in moist woodlands is the *Equisetum sylvaticum*; but, although this has been long cultivated in Europe, it is seldom met with here in a collection of native plants. *Sanguinaria Canadense* (bloodroot), *Hepatica*, nearly all the violets, *Sedum acre*, *Arisæma triphyllum* (wild turnip), *Podophyllum peltatum* (mandrake), several of the *Trilliums*, the *Pogonatum*s and *Smilacina*s, the *Anemones*, *Clintonia borealis*, and many other charming native plants, grow well among the ferns, some of them blooming before the fern-fronds are large enough to overshadow them. We may even have the pleasure of blossoming the exquisite little *Claytonia* (spring beauty) in the out-door fernery. On the upper rocks the saxifrage will flourish; and, among the foreign plants which may be introduced among the ferns, *Lysimachia nummularia* (money-wort) and *Vinca* (periwinkle) are valuable. In bringing the plants from the woods to the garden, it will be well to remove plenty of earth with them: and this will be the source of many pleasant little surprises; for during the second season many small plants, which were unnoticed or mere seedlings at the time of transplanting, will make their appearance in this soil. In this way the writer has found introduced into his fernery *Potentilla*, blackberry-vines, *Anemone nemorosa*, *Smilacina bifolia*, and other excellent additions to the collection. Of course, by the

same process are continually being brought in new forms of *Erechthites* (fire-weed) and the ubiquitous *Nabalus*, and the asters and golden-rods will overtop the minor plants; but these can be weeded out or pruned, so that to bring a large mass of earth with every fern-root will be, on the whole, beneficial. Many of the mosses, particularly the *Hypnums*, will grow in the crevices and among the rocks, although it will be difficult to preserve them during a dry summer. Among the prettiest (and the commonest too) are *Hypnum splendens*, *H. molluscum*, *H. tamariscinum*, *H. cupressiforme*, *Bartramia pomiformis*, *Polytrichum commune*, several species of *Bryum* and *Dicranum*, and the annual *Funaria hygrometrica*. Among the *Hepaticæ*, the *Marchantia polymorpha*, with its little umbrella-like fruiting, is very attractive, and can be easily grown in a damp place.

Among the shrubs which will endure partial shade, and serve themselves to produce still more for the ferns, some may be chosen to add to the collection. The *Magnolia glauca* and *Kalmia latifolia*, although difficult to establish, when once well rooted, will repay many former failures. The flowering dogwood (*Cornus Florida*) and the spice-bark (*Laurus Benzoin*) are very charming plants, and sometimes grow into trees of moderate size. The woodbine (*Ampelopsis quinquefolia*) and the wild clematis (*Clematis Virginiana*) are invaluable

for draping and concealing the fences and out-buildings of the town garden, and in the country are no less an addition to the fernery, where they will climb gracefully over some old stump introduced for the purpose, or along the rude stones of the rock-work which supports the ferns.

The natural soil of the place where a fernery is to be established may be unsuitable for these plants, and it may be necessary to prepare a better one. In this case we should employ a teamster to obtain a few loads of light meadow-peat, or leaf-mould from the woods. This, if well mixed with the upper soil of the garden, by turning them over together a few times with the spade, will serve for almost any one of the plants already named, as they scarcely ever require more than a foot of reasonably good soil in which to grow. For the trees, of course, a greater depth of suitable earth is necessary.

As a general thing, the falling leaves and prostrate fronds of the ferns will give all the protection required for the out-door fernery during the winter. If its situation be much exposed, or if among the plants are some exceptionally tender ones, it will be well to give additional covering, which should be lightly placed over the plants. If too much be laid upon them, or if the covering become matted together and soaked with rain and snow water, there is danger of decay and death among the ferns.

The writer has endeavored to ascertain, by correspondence with persons interested in this branch of the subject, to what extent ferns are cultivated in various parts of the country. The results of this are hardly as satisfactory as could be wished. It appears to be the fact, that there are as yet comparatively few who have cultivated ferns for a sufficient length of time to enable them to give any definite information. The principal out-door collections are at the North, chiefly in New England, where the limit of the number of species which may be cultivated can be pretty definitely determined.

The following lists are arranged to aid beginners who may desire to cultivate our native species of ferns : —

List of North-American Ferns which are perfectly hardy in the United States and Canada.

Polypodium vulgare, LINN.	Aspidium spinulosum,
Pteris aquilina, LINN.	SWARTZ.
Adiantum pedatum, LINN.	Aspidium spinulosum, var. in-
Woodwardia Virginica, SMITH.	termedium, WILLD.
Woodwardia angustifolia,	Aspidium spinulosum, var. di-
SMITH.	latatum, GRAY.
Asplenium Trichomanes,	Aspidium spinulosum, var.
LINN.	Boottii, GRAY.
Asplenium ebeneum, AITON.	Aspidium cristatum, SWARTZ.
Asplenium angustifolium,	Aspidium cristatum, var. Clin-
MICHX.	tonianum, D. C. EATON.

<i>Asplenium thelypteroides</i> , MICHX.	<i>Aspidium Filix-mas</i> , SWARTZ.
<i>Asplenium Filix-fœmina</i> , BERNH.	<i>Aspidium Goldianum</i> , HOOK.
<i>Phegopteris polypodioides</i> , FÉE.	<i>Aspidium marginale</i> , SWARTZ.
<i>Phegopteris hexagonoptera</i> , FÉE.	<i>Struthiopteris Germanica</i> , WILLD.
<i>Phegopteris Dryopteris</i> , FÉE.	<i>Onoclea sensibilis</i> , LINN.
<i>Aspidium acrostichoides</i> , SWARTZ.	<i>Cystopteris fragilis</i> , BERNH.
<i>Aspidium aculeatum</i> , var. Braunii, DOLL, KOCH.	<i>Cystopteris bulbifera</i> , BERNH.
<i>Aspidium Thelypteris</i> , SWARTZ.	<i>Woodsia Ilvensis</i> , R. Br.
<i>Aspidium Noveboracense</i> , SWARTZ.	<i>Woodsia obtusa</i> , TORREY.
	<i>Dicksonia punctilobula</i> , KUNZE.
	<i>Osmunda regalis</i> , LINN.
	<i>Osmunda Claytoniana</i> , LINN.
	<i>Osmunda cinnamomea</i> , LINN.

*List of North-American Ferns requiring more care
and protection, yet hardy at the North.*

<i>Lomaria Spicant</i> , DESV.	<i>Aspidium Lonchitis</i> , SWARTZ.
<i>Scolopendrium vulgare</i> , SMITH.	<i>Lygodium palmatum</i> , SWARTZ.
<i>Camptosorus rhizophyllus</i> , LINK.	<i>Asplenium Ruta-muraria</i> , LINN.
<i>Asplenium pinnatifidum</i> , NUTT.	

North-American Alpine and Sub-Alpine ferns — as *Aspidium fragrans*, SWARTZ, *Asplenium viride*, HUDSON, *Woodsia hyperborea*, R. BR., *Woodsia glabella*, R. BR., &c. — are very difficult of cultivation, and can only be made to survive in pits, or any other place, for a brief period.

List of North-American Ferns which are particularly suitable for the greenhouse, but which may be cultivated out doors at the South; some possibly in California.

Acrostichum (Chrysodium) aureum, LINN.	Aneimia adiantifolia, SWARTZ.
Polypodium Plumula, H. B. K.	Adiantum Capillus-Veneris, LINN.
Polypodium incanum, SWARTZ.	Vittaria lineata, SWARTZ.
Polypodium Californicum, KAULF.	Blechnum serrulatum, MICHX.
Polypodium Phyllitidis, LINN.	Woodwardia radicans, var. Americanum, HOOK.
Polypodium aureum, LINN.	Nephrolepis exaltata, SCHOTT.
Gymnogramme triangularis, KAULF.	Aspidium cristatum, var. Floridanum, D. C. EATON.
Pteris longifolia, LINN.	Aspidium argutum, KAULF.
Pteris Cretica, LINN.	Aspidium unitum, var. glabrum, METT.
Aneimia Mexicana, KLOTZSCH.	Aspidium patens, SWARTZ.

Besides the above, there are many ferns, species of *Notholæna*, *Pellæa*, *Gymnogramme*, and *Cheilanthes*, which require special cultivation, and are referred to under that head; but, as they are all natives of this country, there must be places in it where their successful out-door culture is possible. There are still so few experimenters, that we must wait until some one in an apparently suitable location has courage and patience to make the trial.

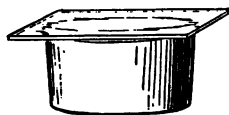
There are still other American ferns which are or might be cultivated; as *Trichomanes Petersii*,

GRAY, *Trichomanes radicans*, SWARTZ, *Asplenium myriophyllum*, PRESL, *Asplenium dentatum*, LINN., &c. The first two of this list can be managed with comparative ease under a bell-glass in any hot-house or fernery.





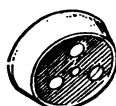
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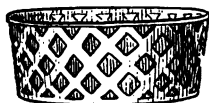
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PLATE VIII. POTS AND PANS.

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CHAPTER VII.

HINTS ABOUT SOILS AND POTS FOR FERNS.

THE composition of the soil in which ferns are to be grown must be left, in matters of detail, to the cultivators themselves. No absolute rule can be laid down, as the modes of fern-growth are so various; and, besides, the materials most readily obtained by one person may not be available to another. The essential thing is to produce a soil which shall be light, and at the same time capable of being made quite firm. Ferns cannot endure a sour soil, or one that will allow the water given the plant to become stagnant. In all cases, a perfect drainage must be secured. Very strong-growing ferns, which root deeply, may be planted, when in pots, with a few pieces of broken crocks at the bottom of the pot, so long as the soil above remains porous; but species of less vigor will require more drainage-material. It is just as important not to overdo drainage as not to neglect it; for, if too much of

the broken material is placed in the pot or fernery, many of the roots of the larger plants will find their way into it, and suffer from want of the nourishment which the earth only can supply. Moreover, if under these circumstances the plant become at all dry, these projecting roots will be the first to perish, much to the detriment of the ferns.

Hardly any two gardeners agree exactly on the best proportions of materials to be used in making up a soil for ferns. Taking an average of their general recommendations, we may safely employ the following for most ferns in pots, ferneries, baskets, &c. : one part peat well broken up, one part leaf-mould from the woods, one part mason's sand, one part virgin loam. The bits of peat will serve for the roots to cling to, while the sand and loam enable us to press the whole quite firmly into place. Instead of the leaf-mould, cocoanut-refuse may be used. This is sold by many of the large horticultural dealers. Messrs. B. K. Bliss and Sons, 34 Barclay Street, New-York City, write that they can supply this material at fifty cents a peck, or one dollar and fifty cents a bushel. For use by amateurs it is particularly valuable, as it is clean ; and it may be employed with common loam, or even quite poor soil, in equal parts, for almost any plants. Meadow-muck, when dried and broken up, can be substituted with advantage for the peat ; but, in this case, it will do to take

two parts of the cocoanut or leaf-mould to one of each of the other ingredients. It is always desirable to have on hand a supply of old *Sphagnum* (bog-moss) for use at the time of making up ferneries or potting ferns. A thin layer of this should be placed over the drainage-material, to prevent the soil from being washed down at the first watering, so as to choke the drainage. The coarser parts of the cocoanut-fibre are also good for this purpose.

A certain class of ferns, coming almost under the head of *Epiphytes*, require a rather different soil. Instances are, *Platycerium alcicorne*, *P. grande*, several *Davallias*, *Oleandra nodosa*, and many *Polypodiums*. For these more peat is necessary; and, for some species, it is only required to fill a wire basket with broken peat, fastening the ferns to the outside. For ordinary pot-culture of this class of ferns, two parts of peat, one of sand, and one of loam, will be a good mixture. Silver sand, mentioned in almost every work on fern-culture, does very well for delicate plants and for spore-raising; but for ferneries and pot-cultivation, and particularly for out-door work, the coarser mason's sand is much to be preferred.

The soil for ferneries of all kinds ought to be well baked, or to have boiling water poured through it, before the ferns are planted. Shirley Hibberd, in "The Fern Garden," gives the following good

advice : "Take a can of boiling water, and water the soil till you have supplied enough to rise to the top of the drainage. The water should be poured into the centre first, to warm the soil gradually. The use of the boiling water is to destroy every insect that may have escaped your eye when breaking up the peat. It will not only do that, but kill their eggs also, and equally make an end of the seeds of weeds and the *mycelium* of fungi; all of which are enemies better got rid of at first, than to be hunted for when their ravages become a source of alarm. The over-cautious may, of course, scald or bake the materials before filling the pan : in that case they should not be put in the pan until nearly dry again.

"When the pan is nearly cold, the ferns may be planted ; and the process of planting will consolidate the compost, so that it will, when all is finished, be an inch below the edge of the pan, as it ought to be : it may, indeed, go below that, and need filling up with some of the finest of the mixture, which should be sprinkled over as a finishing touch."

When ferns are cultivated naturally in a large house, the trouble of potting is entirely dispensed with, and consequently the plants require but a moderate degree of care ; but in a small house, and where they are grown to produce exhibition specimens, much attention must be given to the

suitable character of the pots and pans in which they are raised. The ordinary earthen pots vary much in quality. Those made from poor clay, and insufficiently baked, are apt to become rotten, and break just at the time when it is most necessary that they should hold together. Pots which are over-baked are less porous, and, like common glazed ware, are not so good for most species. Very recently a new kind of pot has been placed in the market, made by Mr. Such of the New-Jersey kaolin from the pits at South Amboy. They are stronger, and can therefore be made thinner, than the common ones. Their color is creamy white; and, although this is not so suitable as red for contrast with the ferns, they are much the most handsome pots for exhibition plants. The figures of pans and pots, given in Plate 8, serve to illustrate these points. Fig. 7 is the ordinary flower-pot; Fig. 6 the same, with one side flattened, that the pot may be placed on a bracket, or against a wall. Fig. 3 is a taller pot for deep-rooting species. Fig. 2, which is shown beneath in Fig. 4, is a small pan (all pans should have more than *one* hole pierced through the bottom, for drainage). Fig. 5 is an open-work pot much used at the Botanic Garden in Cambridge for plants with creeping stems, and also to invert under other pans to raise the plants to a proper height on the shelves. Scoop-shaped pots are often used

for such ferns as *Platycerium*. All these forms may be made to order by any good potter; and every large cultivator will find it desirable to adopt such patterns as are best suited to his particular needs, and have his pots or pans manufactured as they are required.





CHAPTER VIII.

TROPICAL AND TEMPERATE HOUSES.

IT has been previously stated that it is no part of this book to give advice respecting extensive works in any line of fern-culture. The writer is not an architect; nor does he possess a large greenhouse or estate upon which to lay out an extensive fern-garden. Again: a great deal has been written upon such luxurious establishments, in English books and journals: for in Great Britain the fern-mania has long had possession of cultivated and wealthy people; and there, too, the climate aids, instead of frustrating, the efforts of fern-growers. In such periodicals as "The Garden," "The Gardener's Chronicle," "Journal of Horticulture," and "The Gardener's Magazine," published in London, descriptions of fern-palaces are frequently to be found; sometimes accompanied by the architect's elevations and plans, and notices of the more valuable plants which they contain. In "Select Ferns," Mr. B. S. Williams

speaks of many of the most beautifully-kept establishments of private owners; and descriptions of the Royal Botanic Gardens at Kew and other public conservatories, with lists of their ferns, are from time to time published. Among the wealthy cultivators of exotic plants in this country, a large number own beautiful ferns, sometimes remarkable examples of the more robust species; but these are generally grown with the shade-loving plants in pots; and few, if any, attempts have been made to give up any large house to the natural culture of ferns. Mr. Williams (*"Select Ferns,"* p. 23) thus describes the fern-houses of S. Mendel, Esq., of Manly Hall, Manchester: "There are two fern-cries in that place, a tropical and a temperate,—the former being 70 feet in length, 26 in breadth, and 17 feet high; and the latter 96 feet in length, 24 in breadth, and 16 high. They are situated at some distance from the mansion; and, to arrive at them, a beautiful portion of the pleasure-grounds has to be traversed.

"Upon entering the tropical house, such a display of enchanting fairy-like scenery suddenly meets the sight, that a few moments' pause is absolutely necessary to understand the transformation. Commencing to look at the place in detail, one becomes more enraptured at the taste and skill displayed in the arrangement of the rock-work. Here a great boulder is jutting out, there another, cov-



PLATE IX. WINDOW JARDINIÈRE.



ered with *Selaginella*; and these cause the walk to wind round about them, and down into a valley with a small lake, in which are many choice aquatics, the fine pendulous tufts of grass-like foliage of the Egyptian paper-reed (*Papyrus antiquorum*) making a beautiful contrast with such plants as *Dracæna terminalis*, *grandis*, and *Cooperi*, various *Marantas*, many ferns, both arborescent and dwarf-growing species, *Cyanophyllum magnificum*, *Alocasias*, a stately *Theophrasta imperialis*, and many other plants with fine foliage and flower which surround it. The crevices of the rocks are planted with vast quantities of dwarf ferns, and *Selaginellas* luxuriate in every possible place; whilst peeping out from amongst them here and there are such plants as *Goodyera pubescens* and *discolor*, *Cephalotus follicularis*, some handsome-leaved *Eranthemums*, and many other little gems, which are thriving splendidly.

“Passing out into a fern-clad recess, and crossing some water by a rustic bridge, you are in the temperate house. Here also ferns are growing in the greatest luxuriance, the walk winding round masses of stone arranged in a perfectly natural manner, over and amongst which the water splashes and tumbles like a mountain rill. You descend into a valley, and under some splendid specimens of such ferns as *Dicksonia antarctica*, *Cyathea medullaris*, *Dicksonia squarrosa*, *Alsophila*

excelsa and *australis*; and then you are led up so as to get a sight of the tops, which is quite enchanting. The crevices of the rocks have mosses growing in them most luxuriantly; a large number of species, many of them rare, having been collected from their various habitats specially for this purpose. *Todeas* also are the near neighbors of these, and many species of *Trichomanes* and *Hymenophyllum* are beginning to make themselves conspicuous. There are also to be found hanging from the roof in company with ferns, and in various other parts of the house, many orchids from the temperate regions of Peru, Guatemala, Mexico, &c., and thriving well: indeed, the whole collection is in excellent health and keeping."

Shirley Hibberd speaks of several interesting collections; but the establishment which possesses the most merit for originality is that of Alfred Smee, Esq., of Carshalton: "The walls are formed of solid banks of peat, which extend on either side of the plate on which the rafters rest, so as to form borders within and without. The house may be about eighty feet in length. The banks on either side are varied in outline; and there is in one spot a basin tenanted with gold-fish, and surrounded with ferns of peculiarly novel aspect, which are constantly bedewed by the spray from a fountain. The roof is a span running east and west: the south side of it is covered with felt,

and the north side with glass,—a plan which admits abundance of light, and renders shading wholly unnecessary. The whole structure is placed on a slope, the lower part being considerably below the outside ground-level. At this lowest part is placed the furnace, and there is an extra service of pipes there to maintain a stove temperature. At the upper end, the pipes suffice only to keep frost out. Thus in one house the ferns of tropical, temperate, and frigid zones are all accommodated; and though the whole structure is rough, and has been constructed on the most economical principles, the interior presents at all seasons a grand spectacle, and affords a most delightful promenade." — *Fern Garden*, pp. 98, 99.

Of course, to grow to perfection any of the taller species of arborescent ferns, a very high roof, or a dome on some portion of the structure, will be required. *Alsophila excelsa* at the Botanic Garden, Cambridge, Mass., has now reached the glass at the highest part of the house, some twenty-five feet above the floor. This plant is many years old.

Our greenhouses are usually built in summer; and, for this reason, there is danger of our unconsciously making them too weak to endure the strain of ice and heavy snows which the winter of our rigorous Northern climate will bring. Between May and October, it is very hard to realize that those charming designs contained in the English

periodicals will never do for us. Even the architects and builders among us, who ought to know the conditions of climate which are to try their work, frequently seem to ignore them. The unexpected expenses of repairs and alterations soon serve as practical instructors. The trouble with a poorly-constructed plant-house generally begins with copings and joints ; and the best rule in building is, to make every thing outside as strong and simple as possible.

If the house is very high, there should be a gallery or something of the kind within ; for some of the best views of the plants can be only obtained from above. In houses where valuable plants have grown so tall that the glass of the roof endangers their beauty, pits may be dug, rather larger than is sufficient to contain the tubs in which the plants grow. These should be lined with brick. There are several of these pits in the plant-houses of Mr. Such at South Amboy.

The temperature of the tropical house should average, in summer, about seventy-eight degrees Fahrenheit ; but, during intensely hot weather, it will be impossible to prevent its running much higher. In winter the mercury should be kept at seventy degrees, and never, by any accident, suffered to fall to a lower point than sixty degrees. In the temperate house, the thermometer should mark, as nearly as may be, forty-five degrees in

winter ; never, if it can be prevented, over seventy-five degrees in summer.

But, not to speak any longer of such expensive fern-houses as wealth only can construct, there are many persons who can afford a house of modest cost ; and, even if they are obliged to place in it all their winter stock of garden-plants, there is no reason for their being discouraged, and giving up their ideas of raising fine specimens of ferns. A house with a span-roof is to be preferred : but on some accounts, for the mixing of flowering plants and ferns, one with a single slope will do almost as well ; for a wide shelf at the upper part of the back will hold all the plants requiring bright sun, while at the same time it shades the lower portion of the house. If primarily the house is intended for ferns, it should face the north if the roof is a single slope, or run east and west if it is a span. A good size to easily manage for one's self, or with the assistance of one man who is supposed to do the general outside work of the garden as well, will be 30 by 20 feet, with a pitched roof, whose height may vary from 10 to 20 feet, according to the owner's fancy and the height of the plants to be cultivated. In the colder sections of the country, if the drainage of the land upon which the house stands is good, the walls should run much below the surface, and the house become as nearly as possible a roofed pit. The work spent

upon a house should be chiefly to secure comfort to the plants, and security against sudden changes of the weather; and all ornament is purely a matter of pleasure to its owner. In town, where the house is in a conspicuous situation, it may be worth while to consider the addition of any decorations that will not detract from its usefulness; although it must be said that most of the fret-work and jig-saw "trimmings" seen on so many such buildings are an offence to the eye, as they are expensive to the purse. Unless it is certain that the money set aside for adornment will be most judiciously employed, we had best be on the safe side, and do our own decorating with good climbing-plants, trained on the ends of the house exposed to view. Nothing can excel the beautiful work of such natural decorators as *Ampelopsis Vetchii* (or our own *A. quinquefolia*), *Wistaria*, and many other climbers which are hardy in the Northern States. In the more genial warmth of the South, there is almost an endless list of plants available for this purpose.

For the shelves of the house, wood must generally suffice. To save trouble, and give the chance for greater evaporation, an inch of sand on the shelves, as a bed on which to set the pots, is serviceable. For more elaborate shelving, slate is the best material. Common roofing-slates set on the beams make a good foundation for a bench for

bottom heat. The sides can be of wood, and the trough thus made filled with sand. The centre of the house may be made into a raised bed in which to plant out the large specimens, or they may be placed upon it in their pots. If we do not care to grow the plants separately, so that they may be moved for exhibition or other purposes, the house, or as much of it as can be spared, may be converted into a natural fernery, and rocks, water, wire screens, &c., may be introduced. The writer's fern-house may illustrate these suggestions for buildings of limited cost and pretensions.

It was not originally built for the particular cultivation of ferns, and is a single-slope house, 21 by 17 feet, and 13 feet high at the back. It faces the south; yet, with care, as fresh and healthy ferns can be grown in it as in a place better suited in plan to their special needs. And, what is more, very fair success has attended the cultivation of a collection of *Cacti*, *Aloes*, and *Agaves*, upon a shelf four feet below the top, at the back wall.

This house has had only an amateur's care, and has been left, much of the time, to a young man, who, previous to this work, had no knowledge of plants. Although the general out-door duties of the place have also come to him to do, he has given the house such thoughtful attendance, that any thing worthy the name of a loss has rarely occurred. So it seems possible that the fear of the expense

and trouble of a greenhouse need not be so great with any one who has in his employ a faithful man who can spare half an hour a day to its care, and also turn his hand to potting, watering, and the other requirements of the plants, under the eye of the owner; who, by the way, should know something about these things himself.

In this little fern-house, as in larger ones, care has to be taken to screen the plants sufficiently from the sun, as they are more easily burnt than an inexperienced person would suppose. Part of the house is kept shaded all the year; but the rest is not so protected until March, and the screens are removed as early as the 1st of October. The coarse cloth called unbleached sheeting makes excellent screens, and may be used inside or outside of the glass. The use of any sort of wash on the glass, to abate the intensity of the light, gives the place an untidy appearance, and, unless oil-paint is employed, will soon be disfigured by streaks, and come off at last entirely, as the moisture produced by sprinkling collects and runs down the glass. A dark-green glass has, according to Smith, been used in England. He says ("Ferns, British and Foreign," p. 336), "In former years, the fruit and plant houses at Kew were glazed with a very dark-green glass called Stourbridge-green, and which was patronized by the late Mr. Aiton. Fine crops of fruit were produced under it; also the

PLATE X



CHEILANTHES LANUGINOSA NUTT

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tropical plants in the Botanic Garden flourished without the aid of canvas or shade of any kind. Not many years ago, solitary squares of this glass might be seen in the roofs of the old hot-houses, which strongly contrasted with the modern clear glass. My experience with this glass led me to recommend green glass for the palm-house, which was adopted ; but the modern-made green tint does not appear to be so fixed a color as the old Stour-bridge-green." Various kinds of mats and screens will suggest themselves to every greenhouse-owner, and the most convenient things can readily be turned to account.

As for heating-apparatus, there will be no trouble in finding forms enough to select from. It is important to choose one not unnecessarily large for the work it has to do, and yet not so small as to require forcing in very cold weather, or to demand attention during the night. Large furnaces, like most bodies of size, are steadier in their working, and can be as well managed to give a small amount of heat as those of less capacity. The writer has used for several years, in his fern-house, a small Whitely hot-water furnace. It has a "shaking" grate ; and has never, even in the coldest weather, required attention between seven P.M. and seven A.M. Several others of the same pattern have been observed to be successful in their working ; and this form of heater may especially be

recommended for a small house. In the larger establishments near Boston, the Hitchings and Smith & Lynch boilers are most frequently employed. The old-fashioned "saddle-back" boilers are fast disappearing from use. If the chimney is first made to pass through the house in the form of a brick flue, much heat from the smoke is saved; but the danger of the leakage of the products of combustion, which might, in half an hour, allow gases enough to escape to destroy the whole collection, may be an argument against this economy. It creates the necessity of a constant watch to guard against such a result; and the few dollars saved are more than balanced by the difficulty, in dull days, of kindling a fire with the draught of so long and crooked a chimney.





CHAPTER IX.

FERN-CASES.

THE conservatory and the enclosed window are beyond the reach of many people who love ferns, and would be glad to make their homes beautiful by the cultivation of these delicate plants. The desires of such can be answered by ferneries or Wardian-cases, which supply, to a sufficiently large extent and with the least possible requirement of daily care, the domestic means of growing ferns. In dwellings heated by steam, and into which gas and furnaces have not been introduced, a few species of ferns will consent to grow at the northern windows. There is so small a number of these, that they may receive only this allusion. The purpose of this chapter is to explain how, in spite of "modern conveniences" and their continual war against nature, we may contrive to introduce and keep a bit of perpetual summer in our homes.

The fernery, or Wardian-case as it was first

called, is only an adaptation of the cover-glass always used by gardeners to protect delicate plants; and is only doing, on an enlarged and more elegant scale, what our grandmothers used to do to strike cuttings under a tumbler. The lovers of house-plants, however, owe a debt of gratitude to Dr. B. N. Ward of London, who was the first to suggest the present in-door method of treating ferns.

The amateur of unlimited means may order from his cabinet-maker, without consideration of form or price, what will be called in the bill "one fernery;" but it is only a single mechanic in the hundred who will properly construct it. The usual and fatal mistake in building fern-cases is to employ far too much woodwork, and too little glass. Eastlake's favorite word for all furniture is "sincere;" and to the fernery this word should be applied with its full force. The fernery should be made for the purpose which its name implies, and not to be an elegant parlor-cabinet. The simpler its form, the better, so long as its proportions are well chosen. All unnecessary mosque-like domes, all jogs, breaks in the curves, and mouldings, should be carefully avoided. It has been observed, at the exhibitions of the Boston Horticultural Society, that during the last five years the styles of fern-cases have steadily improved. One case can, however, be called to mind, that resembled a child's coffin more than any thing which could

suggest the idea of a fernery, which was not very long ago placed on view by a proud contributor, and which, it is to be regretted, obtained a prize. Six months later the owner was forced to remove the cover, that the plants might rise to any thing like their natural height. This planting of ferns which soon become too large for the case is, by the way, one of the most common mistakes made by the inexperienced fern-grower.

To form the frame of the case, iron is preferable to wood, both for strength and lightness. Many styles of cases with iron frames have been recently put upon the market. Plate 11 is a representation of a case which Messrs. M. D. Jones & Co. of Boston manufacture for \$30. The base is six inches deep (inside measure); and the legs, which are 30 inches high, are strongly braced. The case itself is 35 inches by 20 inches, and is 22 inches high from the base to the summit of the curved glass top. The panels in the base are the only woodwork about it, and are ebonized, or may be painted dark Pompeian red, and the ironwork painted red and black, at the owner's fancy. The case may be lifted from the base; and at each end is a door, which, instead of moving on hinges, is arranged to lift out. The top may also be constructed so that it can be elevated for ventilation. Mr. Emerton in his drawing has filled the case with *Nephrolepis exaltata*, *Blechnum Brasiliense*,

two species of *Adiantum*, and a few small species which were growing at the time in another fernery.

The zinc pan, which is usually the receptacle in ferneries for the plants, may be painted inside with a coat of tar (do not use *gas-tar*), or several coats of shellac. It must be so fitted to the table, that the moisture running down the glass inside shall fall into the pan. If the fern-case is so constructed that this water can find its way outside, the metal will rust, and the woodwork decay; and, in a few seasons, a case which might have lasted a lifetime will be ruined.

In Pl. 13 is represented what we shall venture to call the Eastlake Fernery. The frame is of ash, stained dark: the ornamentation is simple tooling and chamfering. The sloping top furnishes a good opportunity for ventilation. There is a door in one side only; and the top lifts from the base, as in the iron-framed case. Mr. J. W. Ayers of Salem, who has given special attention to the manufacture of Eastlake furniture, will make a case of this pattern 24 inches by 16 inches, with a height, including the table, of 49 inches, as seen in the plate, for \$25. The ferns in this case are *Aspidium molle*, *Pteris cretica albo-lineata*, *Adiantum Capillus-Veneris*, *Polypodium Californicum*, *Nephrolepis exaltata*, with *Selaginellas*.

Any one who is fortunate enough to possess a fair degree of mechanical skill can easily make for

himself a case which shall meet all the requirements of fern-growing, and in which the cost shall be reduced to the very lowest possible figure. For a case 24 by 16 by 18 inches in length, breadth, and height respectively, the expense for wood, glass, putty, filling, oil, pan, &c., would cost no more than \$7, while the cabinet-maker's charges would be at least \$15. Cases with a pitched roof should have one side of the top hinged, so that this can be raised by a chip or a bit of paper for ventilation; and every fernery should be so constructed that it may be easily raised from its base.

The writer, who is *not* a good mechanic, wishing to multiply his ferneries without in the same proportion increasing the expense, devised the fern-case represented in Pl. 15. Many other people may have themselves invented the same; but, as the design is not patented, we shall not infringe upon each other's rights. The following directions may be useful to some readers:—

First procure an inch-thick pine board, 24 by 18 inches in size. As our large pines are so rapidly disappearing, it is most likely that this can only be obtained by gluing several narrow boards together. Around this bottom board, and at right angles with it, nail a strip of hard wood (say ash or walnut) four to six inches wide. The top of this strip, or the edge which will come on top, may be bevelled (Pl. 15, Fig. 4), and have, perhaps, a

little groove cut for ornament three-fourths of an inch below the bevel. Before nailing on, glue around the edge of the bottom board a piece of listing to make the joints tight when the hardwood strip is in place. This would make a carpenter laugh; but we are building a fernery where we do not care to keep up a continual and perhaps ineffectual use of the square. When all is dry, give the inside a good coat of tar, or, if it seem necessary, two or three. Of course you can avoid all this trouble by being at the expense of a zinc pan; but the less costly plan is practically as good. Now procure some German glass (as *flat* as possible), — two pieces *short* 24 by 18 inches, two *short* 18 by 18, and one 25 by 19. Set up the first four pieces in the tarred tray, holding them in place by books piled against them; and paste over the united edges at each corner outside (Pl. 15, Fig. 2) a tape one inch wide, turning it over only a very little at the top, for the condensed moisture will soon loosen any thing pasted inside. After allowing the tape to dry, cover it with a strip of dark paper; and also bind the edges of the fifth and largest glass, which is to lie flat and unfastened on top as the cover, with the same. Remove the books, and the fernery is completed as we see it in Pl. 15, Fig. 1. Of course these proportions may be varied; and a portion of the glass which seems wasted by going into the tray may be saved by

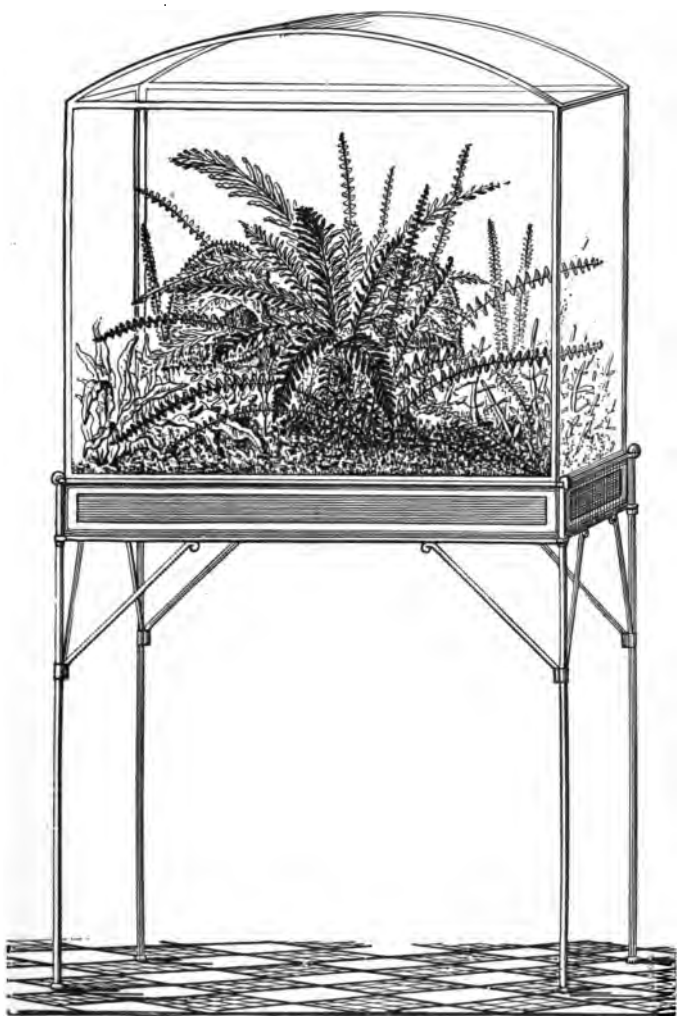


PLATE XI. IRON-FRAMED FERN-CASE.

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fastening blocks of wood inside the tray, — one at each corner, and one in the centre of each side and end. The glass will rest on these, only being allowed to come sufficiently below the upper edge of the tray to keep the case firmly in position. As nearly as can be estimated, the cost of such a fernery will be, —

Three feet pine, sawed into shape . . .	\$0.25
Three feet walnut, bevelled and grooved . .	.75
Tar10
Glass	3.25
Two yards tape08
One sheet paper10
Nails05

Total . . . \$4.58

The listing and glue should always be at hand in every house. This fernery has all the essentials of the \$30 case shown in Pl. 11; and the plants will thrive in it as well, perhaps even better. Instead of flour-paste for fastening the binding-tape, the rubber cement made by dissolving pure rubber in benzole or chloroform may be used, or even shellac varnish; which latter may be improved by the addition of a little of the rubber solution. Or, again, the glass may be set in an inexpensive zinc frame soldered at the corners. If a zinc pan is desired for a case of this description, the joints in the base need not be made tight; but, the list

and glue being omitted, the moulding or strip of hard wood may be nailed directly to the bottom board as shown in the section, Pl. 15, Fig. 3.

The examples so far given are only to show the extremes in expense of fern-case manufacture. The space to be occupied by the fernery, the height of the window at which it is to stand, &c., must, in each instance, be considered. As the window is high or low, the supports of the fernery must be long or short, so as in either case to bring the pan to a level with the window-sill; for, although ferns do not endure the direct rays of the sun, they do not flourish in a dark room. Besides, a situation in a living-room, which may seem to us very well illuminated, may not possess the quality of light in which plants thrive the best. A good illustration of this point, regarding the actinic power of light, is at hand. The photograph which forms the frontispiece to this book was taken in a greenhouse whose top of glass is exposed to the south, and required an exposure of two and one-fourth minutes in the camera. Immediately afterwards, on the same day, a view was taken in a well-lighted room of the dwelling-house adjoining. The exposure here required with the same lens was twenty-six minutes. It is probable that the same quality of light required to produce a good negative is also necessary to produce good plants.

As a general thing, very large cases are more difficult to manage than smaller ones. There is a possibility of getting them too large. To counteract some of the troubles which attend over-sized ferneries, they are sometimes artificially heated. This may be done by applying heat to pans of water in which the fern-pan is placed, or by coils of piping passing under and around the pan. The water in either case may be warmed by a lamp or stove outside, or connected with the water-heating apparatus of the dwelling. The writer has had no experience with cases so warmed; but, in his judgment, coil-heating is to be preferred, as it will render it less troublesome to move the case, and as the drainage of the fernery can be better effected between the heating-pipes at the bottom than through a reservoir of warmed water which covers the entire under surface of the case. Shirley Hibberd, in "The Fern Garden," proposes a plan for draining a fernery warmed in the latter way; but the coil system seems the best. All this piping should be done by an experienced plumber, as it requires considerable skill so to adjust every thing that the water shall flow with regularity. Mr. W. H. Halliday of West Street, Boston, has given much attention to the construction of fern-cases, having dealt in them for several years. In a paper read before the Massachusetts Horticultural Society in January, 1876,

he gives the following account of some of his experiments:—

“I had two large windows facing the south; but a building obscured the rays of the sun part of the time. In the windows I placed two cases, each forty inches long by eighteen inches wide. The box was six inches deep, with an inner box fitting loosely to receive the soil. An inch moulding fitted around, projecting half an inch above the box, to receive the sash. The sash was on two sides fourteen inches high, the ends solid, and the inside faced with mirrors. You will readily see that I introduced the mirrors to double the effect, and render the whole more beautiful. Upon this sash was a top ten inches high, sloping on the two sides, which fitted to and was kept in place by an inch moulding. This top could be removed to reach the plants, or tilted up a little if ventilation was desired. One of these cases I devoted to native plants, the other to exotics. I made many trips to the woods, and my case of natives was soon in a prosperous condition. I filled it with all sorts of plants that happened in my way, among which I remember the blood-root, hepatica, trailing arbutus, pitcher-plant, *lycopodium*, *Mitchella repens*, *Polypodium vulgare*, and *Adiantum pedatum*. All these did remarkably well; but I found, when winter came, that many of them dropped off to sleep, and the curtain fell for the season.

“Having had such good success with these cases, I thought I would try one on a larger scale. The plan was soon in the hands of the cabinet-maker, and in due time made and set up in its allotted place. This was made very large, for an experimental case. Many of you will remember it, as it was exhibited in this hall, four or five years ago, at the Annual Exhibition. It was nearly four feet square, and stood six feet high from the floor to the top of the roof. The box

stood two feet high, set on heavy casters, and moving on a pivot, so that it could be readily turned to the light as the plants required. The inner box was half an inch smaller than the outside all round, eleven inches deep, thoroughly covered with white-lead paint, and perforated through the bottom with inch holes for drainage. The glass case, thirty inches high, fitted into a moulding projecting above and around the top of the box. The sash was made very strong, with iron braces set into each corner. Each of the four sides consisted of two panes of glass, two panes on two sides serving as doors. The roof was formed of four sloping sides, surmounted by a flat cap of wood twelve inches square, tapering upward, with a turned point twelve inches high. This cap fitted on like a cover, and could be easily removed if necessary. The case was thoroughly painted with three coats of white lead, and cost, when completed, seventy dollars."

This introduction of mirrors would only be proper when the fernery was so placed that the ends were hidden from view. The remarks concerning native plants in the fernery cover the ground; for, if we desire to have growing plants in winter, we must take species from the tropics, which need little or no rest. Native plants are best out of doors; or they should be suffered to remain over winter in a cool place, and only brought in early in the spring to unfold. They are therefore particularly suited, if kept in this way, for the open in-doors fern-stand.

Farther on in his essay Mr. Halliday says, —

"But, after a while, the case did not work as well as I

expected. The ferns did not do well at all, but damped off, till I grew quite discouraged. I continued to replace the decayed plants by others, with no better results. I thought the trouble might be caused by want of heat, as the room at night and on Sundays, when I was not on hand to look after the fires, might become quite cool. With this thought came the idea of heating the case. I had made at the tin-man's a small boiler holding a gallon of water. Behind the case, near the floor, I placed a gas-jet, and over this the boiler, removing a panel from the box of the case, then fitting it so that it could be opened or closed at pleasure. The inner box, containing the soil, being eleven inches deep, left a space of twelve inches underneath: in this space I placed tubing enough to extend completely round the case, and to connect with the boiler outside. All seemed to work like a charm. I then went to work to ventilate the case, giving a little air at a time; till at last I removed the square of wood from the roof, and replaced it with a piece of plate-glass, which I could remove wholly or in part; and this, with the aid of the panel which was opened for heat, furnished the means for ventilation. I soon saw that it was the one thing needed. Every thing worked well from this time."

The subject alluded to here, that of ventilation, must receive especial attention. Some have the erroneous idea, that, to fully carry out the theory of a fernery, we must almost hermetically seal the case. But, while a few species of *Hymenophyllum* and *Trichomanes* may live under such conditions, the majority need air in limited quantities. A little slide in either the woodwork or the glass below, with one also at the top to permit a

gentle circulation outward, will supply all that is necessary. Too much air is as bad as too little: so, like every thing else connected with fern or plant culture, judgment must be used. It is absurd to try to grow plants by an inexorable rule, without varying their treatment according to the circumstances and requirements of each; just as the same inflexible system would fail to succeed with children of different constitutions and capacities. If a person, moreover, has no love for plants, no intuitive sense of how to manage them, he will undertake a hopeless task in the endeavor to cultivate them because it is fashionable, or because of their artistic effect in the house.

A kind of combined greenhouse and fernery is sometimes made by devoting an entire window to this purpose, either by constructing a "bay," or building up on the inside an enclosure sufficiently deep to hold as many plants as are desired. Ventilation or heat can be supplied by openings near the top and bottom. A zinc pan will be needed on the floor, and some little distance up the sides, to catch superfluous water, which now and then can be drawn off through a pipe and faucet from the lowest corner, and opening into the room. Ivies, climbing-plants, and plants in hanging-baskets, flourish well in such a place, as do also all ferns which would be suitable for a large fernery. The inner glass should be set in

large doors, so that the whole may be thrown open towards the room, and all the plants be reached at any time.

For circular ferneries, any bell-glass or glass cover on any kind of dish has all the practical value of any of the most elaborate and expensive parlor stands. Broken retorts from the laboratory have been converted into charming fern-cases. But best of all is the glass dome which has for years covered the fast-dropping bouquet of wax flowers in the best parlor. This, in connection with a deep old Delft plate from the cupboard, may become of some real service, and, filled with pretty ferns, make the living-room smile with its suggestions of tropical warmth.

The black glass or "slag" ware makes the cleanest base for the circular fernery. It is sold in all sizes at a very reasonable price. Great care must be taken that the glass cover fits loosely into the base, as it is likely to snap if it is held too tightly. Pl. 17 shows a fernery whose base is of this ware. It seems as good as ever, after a service of many years. The terra-cotta or earthen-ware bases, some which are well decorated, are very pretty; but in time the absorbed moisture causes the paint to peel off, and they become hopelessly shabby. In the paper previously referred to, Mr. Halliday describes a hanging-fernery, which the writer remembers to have been especially attractive:—

PLATE XII.



CHEILANTHES CALIFORNICA, METT.

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"The hanging-fernery I designed to take the place of the hanging-basket, which so seldom appears in good condition in the home. The base was turned from walnut, several pieces being glued and nailed together to get the proper depth, and also to keep the wood from warping. It tapered to a point at the bottom, to give lightness to its appearance. A zinc pan, with a rim to receive the shade, fitted the base loosely enough to be readily removed when watering was necessary. This, as first constructed, was covered with a shade eight inches in diameter and ten inches high, and was suspended by silvered copper wire. The case first exhibited had a shade twelve inches in diameter, and fourteen inches high; was elaborately turned from maple and walnut, ornamented with ebony trimmings, and filled with the following-named plants: *Onychium Japonicum*, *Adiantum assimile*, *A. cuneatum*, *Selaginella Wildenovii*, *Panicum variegatum*, *Fittonia Pearcei*, *F. argyroneura*, *Lycopodium denticulatum* var., and *Mitchella repens*, some lichens and wood-mosses.

"This case, when taken from the hall, was suspended in my window, where it received the morning sun for about an hour each day, and was not disturbed again till January, excepting when it was occasionally turned to the light. It was a mass of green. I noticed considerable soil on the glass, carried up by slugs in their nocturnal rambles; also some decayed fronds of the *Adiantum*. Altogether it was as much of a success as a close case could be, and would probably satisfy most people who grow plants for home decoration."

He also says, —

"The great difficulty I have always found in ferneries is to reach the plants after they have filled, or partly filled, the case. It is easy enough to remove the shade; but to replace it, so that the plants may retain their former position, is not so easy. Frequently I have been forced to allow a

large slug to have his own way, rather than disturb the shade when the case was looking finely; and, in many instances, have allowed decayed fronds to remain, rather than run the risk of destroying the arrangement by removing the shade. It was almost as much on this account as for ventilation that I constructed the dome-top or ventilated fern-case, which is as easily managed as an ordinary Wardian-case. Lifting the dome does not disarrange the plants, as they are all confined within the cylinder, which need never be disturbed for this purpose. This case is constructed as follows:—

“The case or stand is of wood, six inches deep, and resting upon three small feet. There is a large opening underneath, covered with a movable slide to admit or exclude the air. It has a zinc pan one-half an inch less all round than the wooden case. This half-inch space is covered all around at the top of the pan, which leaves a flat surface of zinc one inch wide, with an outside rim to receive the glass cylinder. This flat surface of zinc is pierced with half-inch holes in its entire circumference about three inches apart. When the glass cylinder is in place, the half-inch holes are inside the case. The cylinder, of annealed glass, fits neatly into the zinc rim, and is fifteen inches in diameter by fourteen inches in height. Encircling the upper edge of the cylinder is a copper rim, one inch wide, with edge turned downward on the outside, a quarter of an inch wide, to fit on to the cylinder. The flat surface of the rim is perforated with quarter-inch holes; and the inner edge turns up a quarter of an inch to receive the dome, or cover, which is eight inches high, and twelve and a half inches in diameter. The holes in this copper rim are on the outside; so that, when the valve in the bottom of the case is open, the air passes up through the holes round the zinc pan, and out at the copper rim. The whole case, when complete, stands twenty-nine inches high.”

The ventilation of the circular fernery is more

difficult than that of the larger cases of wood or iron. It will often be enough to tilt the shade up on one side by inserting a chip under it, so that a little air may be admitted. An excellent plan, as the writer can certify from trial, is suggested by Shirley Hibberd :—

“In the case of fern-shades which fit into glass dishes, and which, as long as there is water lodged in the rim into which the lower edge of the shade rests, are air-tight, air must be given three times a week by removing the shade altogether for an hour or so. This allows the excess of water to dry off the foliage, and prevents mould; and, the glass getting dry in the mean while, it is prepared to take up a fresh supply of moisture from the soil when replaced, which is equivalent to a circulation of water as well as a change of air. This air-giving, however, must be regulated by discretion; for, if the air of the room is hot and dry, sudden exposure of the plants to it may do them harm. Moreover, it is a very easy matter to remove the glass, and *forget* it, the result being perhaps complete destruction of all the more tender fronds, and the disfigurement of the affair for a fortnight. Now, a very simple and expeditious and effectual mode of ventilating consists in taking off the glass, wiping it dry and bright, and replacing it at once. There is then no fear of forgetting it.”

Fernery-bases may be made of any required size and depth at almost any pottery; and if, like a flower-pot, they have holes pierced in the bottom, and are fitted with saucers, their contents may be treated exactly like potted ferns in the greenhouse. They are more clumsy in appearance, but have

many good qualities. It is to be hoped, that, out of the prevailing mania for decorative art, some designs for pretty and useful fernery-bases may be evolved.

The illustration (Pl. 18, Fig. 2) is a pretty Japanese design from an English work. The shelf below holds a jar; and the base of the fernery is a shallow Chinese bowl, such as one often sees in the old houses in Salem and Boston. Pl. 18, Fig. 3, is an original design. The base is a Russian bowl, of the same sort as is recommended by Clarence Cook for a hands-basin in the hall, and is secured to the legs, which are made from a bamboo fishing-pole, by bolts with nuts inside the bowl. A wire runs through the legs, where they cross, to make a firm joint. Within the bowl there should be a zinc pan in which to plant the ferns. The cost of the whole, without the glass shade, was two dollars and fifty cents.

As regards drainage, the case may or may not have an outlet. Under proper care, it does not need one. But, to insure complete drainage under any circumstances, it is well to have an opening wherever it can be conveniently arranged. A common kerosene-lamp bulb, such an one as is placed in the usual iron bracket-ring support, is as good as any thing for the receptacle for superfluous water. A burner may be found to

fit the screw collar of the bulb: then all of the burner must be cut away except its ring or tube carrying the thread of the screw which fits the bulb-collar. Now solder this remaining portion of the burner to an opening made in the bottom of the fern-pan, so that the tube with its thread projects below. To this the bulb can then be screwed, and will serve as a reservoir for the drainage of the pan. Exactly such an arrangement may be found on a German student-lamp to catch the drip of oil from its wick-holder. The bottom of the pan should be sloped, or indented with grooves, to direct the flow of water towards the opening to which the bulb is fastened. If such drainage cannot be arranged, and it is suspected that the fern-case is suffering from too much water, and that the drainage-material in the bottom of the pan is filled up, a hole can be pierced in the bottom, near one corner, and some vessel placed or hung permanently underneath to receive surplus water; and, if now the case be so tilted that the water will run toward the opening, all excess will soon be drained away. In filling the case or pan, it will be found that fragments, the size of a half-dollar and smaller, of broken flower-pots or similar material, will be best for drainage-purposes. There should be enough of them to cover the bottom at least two inches deep; and to prevent the earth with which the

pan is to be filled from washing into this drainage, and choking it up, a very thin layer of *Sphagnum* moss or hay should be placed over it. Should broken flower-pots not be at hand, any earthenware might be made to answer, or even small broken stones, or even pebbles, as a last resort. As circular ferneries are generally constructed for sale, we seldom find any provision for the escape of surplus water : greater care is therefore to be taken with such, to guard against over-watering. Good drainage is of equal importance for ferns in pots or window-boxes. A short experience will teach us that it is the most important thing to be considered, and quite as essential to the health of the plants as a good system of sewerage is to that of the human family.

Ferns, in general, should be often sprinkled on their tops ; but their roots should only be watered when the earth in the case seems to be growing dry. If we have Gold-Ferns or Maidenhairs, we must keep water away from their fronds. A clothes-sprinkler is a good apparatus to use for fern-watering, as with it we can see exactly how much water is applied, and know that we are not giving an excessive supply. Williams gives the following advice regarding ferneries : "Do not keep your ferns too wet. To grow ferns in perfection in glass cases, they ought to have fresh soil every year ; and the best time to effect this

operation is in March or April." Much less fear may be felt of changing the earth of ferneries, or transplanting plants in the greenhouse, than of doing the same to plants under ordinary window-culture or out of doors, because the glass keeps the air stationary about them, and prevents that evaporation of moisture which the lately-disturbed rootlets have not recovered sufficiently to supply, while the circulation of air around plants growing out of doors or in the dry atmosphere of the living-room is almost sure at times to baffle our attempts at transplanting.

Very pretty effects may be produced in a fern-case by the use of pumice-stone broken into reasonably small pieces. Druggists sell this material for about ten cents a pound. In small ferneries, a few fragments may be used to form a rockery for the creeping ferns ; and, in a large case, arches, walls, and ruins may be built with it very easily. Common cement, mixed as if for mending walls, may be used to lay the pumice in ; and, as this sets quickly, almost any design can be very soon built. The whole structure should be finally washed with a thin mixture of cement, to give it the proper color.

Old logs look well in a fernery ; but they are so apt to introduce insects and fungi, that we should not be in too much haste to insert them. If the case is a lofty one, we may, with good effect,

hang up a basket of cocoanut shell or husk, or of bark, with a fern growing in it. The *Tillandsia* (often miscalled Southern long *moss*) sometimes grows well thus suspended from the top. Orchids are very interesting, but require more room than can generally be spared for them; and, besides, they are too valuable to risk in a fernery, if we have a greenhouse in which they may be kept. Whatever is added, do not introduce too great a variety of objects. Remember that it is a *fernery*, not a *curiosity-box*, of which we are speaking.

In allusion to the ornaments which are often placed in ferneries, Williams says, "Care must be taken, however, that such things are not studied at the expense of the ferns or other plants. The error of fitting up a fern-case with a quantity of objects of curiosity, such as fossils, shells, minerals, &c., is one too often fallen into, and the ferns become only of secondary importance." Eastlake would give us the same advice, not only in regard to the contents of the case, but its construction as well. If the case is to be a *fernery*, build it, no matter how little or how great you make its cost, *to contain ferns*, so that they will be the objects first considered when looking at the case. Over-adornment, inside or out, is in bad taste; and too much woodwork in proportion to the glass shows wrong ideas in construction. Fern-



PLATE XIII. EASTLAKE FERNERY.



cases are sometimes seen in which there is so little glass, that it seems like a panel of some choice material set for display in a splendid moulding, as costly tiles might be mounted in the *jardinière*. Now, the less conspicuous the material which forms the frame to hold the glass, whether it be wood, iron, or paper, the better it is. And, even when made as light as possible, it should be painted or stained a color which may still farther reduce its prominence as seen among the plants. For this purpose, chocolate, or brick-red with black, will do as well as any thing. The chocolate-color recommends itself also for the interior of a greenhouse, as it is complementary to green, and plants and fronds look well against it. For the same reason also, black-walnut, dark mahogany, or other deep-reddish woods, are most suitable in color for the construction of the frame of the fern-case.

Other plants than ferns can be successfully grown in cases; but they are comparatively few. A list of the best will be given at another page of this book. For circular ferneries, the most beautiful of all such plants are the *Selaginellas*. They grow best when left to themselves, and, as they do not mind close quarters, will not require that the shade be lifted for a long time, — sometimes for months.

Finally, keep the fern-case near the light, but

not in the sun. Eastern, northern, or western windows are better than a southern exposure. Above all, do not attempt to manage by rule ; but be moderate in all things, and continually use common sense.





CHAPTER X.

FERNS IN THE LIVING-ROOM.

THE design given in Pl. 9 is a combination of ideas, having had for its first suggestion the plan of a window in Mr. E. C. Gardner's very attractive and sensible book, "Home Interiors." Mr. Emerton has added the *jardinière* and appropriate wall-decorations.

The *jardinière* has two compartments, the one next the window being ten inches higher than the one below. In the former it is intended to place the sun-loving plants, — *Pelargoniums*, *Petunias*, *Fuchsias*, *Dracænas*, &c.; and in the lower portion, where they will be in partial shade, the ferns are to be grown. The interest of the design does not end with the plants themselves. The frieze around the room has a *Camptosorus* for the figure, and India palm-leaf fans are fastened along it at intervals. The wall-paper is of a morning-glory pattern, with a border of butterflies at the top, and, at the bottom, one of spiders; for which

last decoration Mr. Emerton is responsible. The tiles in the *jardinière* are supposed to have been adorned by the lady-owner with a conventional *Sagittaria*; and the whole represents, in part, what a true lover of flowers, who is also something of an artist, has made of the living-room.

Ferns are not often found under cultivation in the dwelling-house. Their successful growth without the protection of glass presents so many difficulties, that efforts in this direction are not much encouraged. They dislike dry air, dust, and gas; and therefore they do not flourish under the ordinary circumstances of our houses. In rooms moderately heated, where no gas escapes from stoves or furnace, and especially where the pressure from the gas-meter is not so great as to drive half-consumed burning-gas into the air at evening, many species may be made to do well in pots. But little need be said regarding the management of ferns grown in this way, besides repeating the injunctions already given more than once concerning good drainage, — water at the roots when dry, sprinkling, and northern window, or partial shade.

Pl. 21 is taken from an elegant Chinese stand and *jardinière*. It was originally designed for the cultivation of bulbs, of which the Chinese are particularly fond, and with which they have marvellous success. But, as a fernery, it is very beautiful;

and, as the receptacle for the plants is of soapstone, it may be sprinkled without injury.

Among the ferns suitable for open in-door culture are —

Nephrolepis exaltata.
Nephrolepis tuberosa.
Onychium Japonicum.
Adiantum formosum.
Adiantum hispidulum.
Gymnogramme chrysophylla.
Gymnogramme calomelanos.
Davallia Canariensis.
Pteris tremula.
Pteris serrulata.
Pteris quadriaurita, var. argyrea.
Platyterium alaicorne.

Very pretty arrangements of our native ferns and mosses are made by many persons of taste during summer journeys among the mountains or other places where these plants abound. For this work tall-growing plants should not be chosen, but the collection made of the smaller species; nor should the charming little "Solomon's Seal," "Trientalis," "Gold-thread," &c., be excluded because they are not ferns. The extemporized frames in which these are arranged will probably be box-covers, or whatever is accessible at the time, and probably, too, be covered with birch-bark. A friend who had, one autumn, two such stands of ferns and mountain-plants, found that, as winter came on, the ferns lost

their beauty, and the whole became disagreeably brown. The boxes were taken out, and placed under some shrubbery, where they remained in snow and ice till a mild day in February; when they were taken into the house, and thawed out. In March the boxes were a mass of beautiful young fern-fronds, *Arisæmas*, *Coptis*, *Smilacinas*, &c. The exposure had somewhat broken the boxes; but a little birch-bark on the outside easily restored their good appearance. Whenever our native ferns are grown in this way, it must be remembered that they need their natural winter's rest.





CHAPTER XI.

SPECIAL WAYS OF GROWING FERNS.

THE ordinary treatment in the greenhouse or fernery, under which most plants will flourish, will not answer for certain ferns. Their special wants must receive particular consideration. Foremost among these exceptional plants are the "Gold" and "Silver" Ferns. They are chiefly species of *Gymnogramme*, *Notholena* (Pl. 2), *Cheilanthes* (Pl. 6 and 10), and *Pellaea* (Pl. 4). Nearly all are ferns which appear to have the power of living a part of the time where the air is dry. The genera to which the Gold and Silver Ferns belong contain also other species which have no white or yellow powder upon their fronds. Almost all the ferns of the above genera can be cultivated in the temperate house, although some species may seem to flourish better in the tropical house; but, as they prefer less moisture overhead than most ferns, the temperate house will, on the whole, be the best place for

them. They require only the same soil that is suitable for other ferns, and must, during their season of active growth, receive plenty of water at the roots; but a drop must never touch their fronds, as, if sprinkled like others, they will immediately cease to be gold and silver ferns, and only look like poor examples of other species which have caught the drippings of the white or yellow wash of some fresco-painter. Ferns of this class require less shade than most other species, but will even thrive under a little direct sunshine, provided it be not at noon nor in hot weather. When well grown they are very elegant, and are particularly adapted to exhibition-purposes. They are not, as a rule, good for the fern-case.

The following list contains many of the best Gold and Silver Ferns for cultivation, and also of the forms which have no white or yellow powder, but belong to the same genera, and require the same treatment as the first:¹—

I. *With Yellow or White Powder.*

Gymnogramme chrysophylla, Kaulf. (Lowe, vol. i., Pl. 1, under *G. Martensii*). From the West Indies: powder yellow; fr. 10 to 20 inches long.

G. chrysophylla, var. *Laucheana*, Hort., is a cultivated variety of the last, with powder of a deeper yellow.

G. Peruviana, Desv. From Tropical America: powder

¹ For all abbreviations used in the lists in this book, see explanation following Table of Contents.

PLATE XIV.



CAMPTOSORUS RHIZOPHYLLUS, LINK.

(WALKING LEAF FERN.)

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- white, and covering both the upper and under surface of the fronds; fr. 10-20 inches long, appearing mouse-colored.
- G. pulchella*, Linden (Hk., Fil. Ex., Pl. 74). From Venezuela: powder white; fr. dark green above, 10-30 inches long, 12 inches broad, often forking. A beautiful plant.
- G. sulphurea*, Desv. (Lowe, vol. i., Pl. 5). From the West Indies: powder bright yellow; fr. 6-10 inches long.
- G. triangularis*, Kaulf. (Eaton's Ferns of N. A., *to be figured*: Hk., Fil. Ex., Pl. 10). From California: powder yellow, rarely white; fr. raised on stalks 3-10 inches long, triangular, 1-3 inches wide. This species requires great care in cultivation.
- G. calomelanos*, Kaulf. (Hk., Gard., F., Pl. 30). From the West Indies: powder white; fr. 10-30 inches long, 3-8 inches broad. One of the commonest in cultivation.
- Notholaena nivea*, Desv. (Lowe, vol. i., Pl. 19). From Mexico, &c.: resembles *N. dealbata*, Pl. 2 of this book; powder white; fr. 4-10 inches long. Easily managed.
- N. flavens*, Moore (Hk., Fil. Ex., Pl. 47). From Central America: powder yellow; fr. 6-10 inches long. The same as *N. chrysophylla*, Hort.
- Cheilanthes farinosa*, Kaulf. (Hk. and G., Ic. Fil., Pl. 134). From the tropics: powder white; fr. 6-15 inches long.
- Adiantum sulphureum*, Kaulf. (Lowe, vol. ix., N. and R. F., Pl. 61). Hooker considers this to be a variety of *A. Ethiopicum*, L. From Chili: powder yellow; fr. 6-12 inches long. Difficult to manage.

II. Fronds without any Powder.

- Gymnogramme tomentosa*, Desv. Fr. 10-20 inches long; dark, hairy.
- Notholaena Newberryi*, Eaton (Eaton's F. of N. A., *to be figured*). From United States: fr. white, woolly, 6-12 inches long, about 2 inches broad. A charming plant.

- N. sinuata*, Kaulf. (Eaton's F. of N. A., to be figured).
From New Mexico: fr. 12-30 inches long, scarcely 1 inch broad. Very graceful.
- Cheilanthes myriophylla*, Desv., var. *elegans* (Hk., Sp. Fil., vol. ii., Pl. 105). From Mexico: fr. 6-12 inches long, rusty with scales beneath, finely cut. Very graceful.
- C. hirta*, Swartz (Hk., Sp. Fil., vol. ii., Pl. 101). From Cape Colony, &c.: fr. 10-20 inches long, dark green, glandular. Another form of this fern with broader fronds is frequently in cultivation.
- C. Cooperæ*, Eaton (Pl. 6, this book). From California. Somewhat resembles *C. vestita* of the Middle States.
- C. lanuginosa*, Nutt. (Pl. 10, this book). From Wisconsin, &c. A beautiful fern, but difficult to cultivate.
- C. Californica*, Mett. (Pl. 12, this book). From California. With very finely cut fronds. Difficult to manage.
- C. radiata*, R. Br. (Hk., Sp. Fil., vol. ii., Pl. 91). From Tropical America, &c.: fr. on stalks one foot high, the pinnæ radiating from the top, 8 inches across. A very curious plant.
- C. tenuifolia*, Swartz (Hk., Sp. Fil., vol. ii., Pl. 87). From the E. Indies: fr. 10-20 inches long. A very beautiful species.
- Pellæa densa*, Hook. (Pl. 4, this book). From California. Difficult to cultivate.
- P. geraniaefolia*, Fée (Hk., 1st Cent. Ferns, Pl. 85). From Tropical America. Fr. with the shape and cutting of a rose-geranium leaf.
- P. rotundifolia*, Hook. (Hk., Fil. Ex., Pl. 48). From New Zealand: fr. dark green, 8-15 inches long, 1 inch broad. An excellent basket-plant.
- P. ornithopus*, Hook. (Eaton's Ferns of N. A., to be figured). From California. A stiff plant, but quite interesting, and managed with comparative ease.

The *Hymenophyllaceæ* (ferns of the genera *Trichomanes* and *Hymenophyllum*), and also the *Todeas* (which belong to the *Osmundaceæ*), require greater protection than is afforded by the ordinary greenhouse. Therefore bell-glasses or cases must be arranged for them in some very shady place. The cases must be water-proof on the outside, since they will unavoidably be frequently wet while other plants are being watered, or the drip from the roof may fall on them. The earth in the centre of the case in which these ferns are grown should be somewhat raised, and small stones added to furnish a support for the little running stems to fasten to. Some species of *Trichomanes* and *Hymenophyllum* will grow well on the trunks of tree-ferns in the tropical house. *Todea superba* and *T. hymenophylloides* are plants beautiful beyond description. Without enumerating the species of these genera, it is safe to advise similar treatment for all, and to say that any species are desirable. They all require special care as to drainage, and all like a loose, fibrous soil, with some sand. As their fronds are only one cell in thickness, they are too filmy to expose to any currents of air. They prefer to live in a kind of steam-bath all the time, unless the earth they are in is not too wet. They often succeed well in a fernery, if a case can be devoted exclusively to them; and, if you can obtain the plants to fill such a case, it is a piece of great good fortune.

Ferns in baskets are best adapted to the greenhouse ; although, with care, a few species may be made to endure the living-room. The ferns which throw out their fronds from a running stem are best suited for basket culture. The one figured (Pl. 20, Fig. 2) is *Davallia bullata*, and has been growing, as shown, five years without change, a little new earth being occasionally introduced at the top. The best baskets are those made of galvanized iron wire, with the meshes only sufficiently fine to support the moss with which the basket should be lined before introducing the earth. This should be made of coarse peat, sand, and loam. The fern may be planted on the top ; and, if it is of the proper sort, it will soon find its way all over the basket. Sometimes the moss grows too, making a most charming foundation of green. Baskets may also be made of bark fastened together with wire. They can be watered by dipping them into the tank or tub, which should always be handy in every greenhouse. The wire cylinder (Pl. 20, Fig. 3) is made of the wire netting used for window-protectors, the front of furnace air-boxes, &c. It should be galvanized ; and, having been shaped into the cylinder, it may be held in form by wire. It may be filled like the baskets, having been, like them, lined with moss ; or it may be filled with peat, sufficiently large pieces being used to remain in place, and not sift out through

the meshes of the wire. The ferns, when planted at the base of the cylinder, will in time find their way to the top ; and, when one cylinder is covered, another may be added. An erect young fern may be planted at the summit, to grow while the climbing species are winding their way upward.

A very attractive addition to the greenhouse may be made by covering the back wall of the house with a coarse wire screen, which should be about six inches from the wall, the space between being filled with coarse peat or other suitable material. The front, against the screen, can be lined with moss, if desired. On the outside any of the basket-ferns, *Selaginellas*, *Begonias*, &c., can be planted. In a short time these will form a beautiful background for the plants in the house. A screen of this description is in the fern-house of Professor C. S. Sargent of Brookline, Mass. It is watered by attaching hose to a pipe, which, in turn, connects with the gutter at the upper part of the house, nearly hidden by the highest plants on the frame. This, when filled, allows the water to slowly filter down through all the soil, watering the whole in the most perfect manner. This expensive method may, however, be dispensed with, and the sprinkler used instead ; but care must be taken to thoroughly do the work.

One of Shirley Hibberd's most clever sugges-

tions is the cocoanut-shell hanging-basket (Pl. 18, Fig. 1). He speaks with truth when he says that "it requires a sharp saw and some patience" to make one. About one-quarter of the shell should be sawed off; and, to bore the holes, it is best to use a small "pod" bit first, and then a rimer to enlarge them, to avoid splitting the shell. The illustration is taken from a cocoanut-shell in which *Adiantum Ethiopicum* has been growing for five years; and the writer had another basket of this kind, in which *A. affine* grew for a similar extent of time. These baskets may be suspended by the "silver string of the Spanish guitar," or, less expensively, by copper wire. The holes should be from one-half to three-quarters of an inch in diameter, and may be bored or burned out, as one prefers, about an inch apart all over the shell, two small ones being made near the upper edge for the suspending wire. The fern is to be planted as in a flower-pot, only such species being chosen as are characterized by underground buds (described in the chapter on Structure). These buds soon find their way to the holes, and appear outside with their little tufts of green. These shell baskets are particularly good for the creeping species of *Adiantum*.

The following species are suitable for cultivation in baskets, hanging-pans, wire cylinders, screens, &c.:—

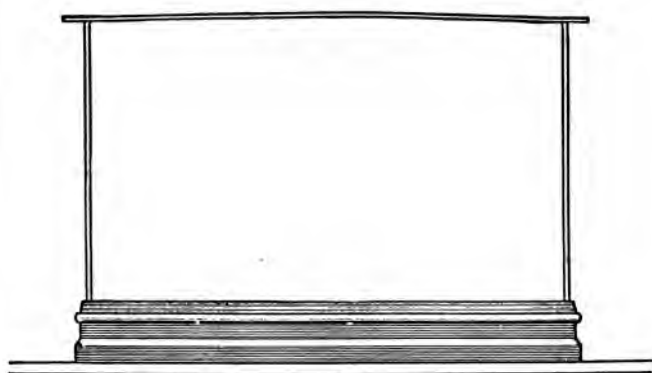
- Adiantum affine*, Willd. (small).
A. caudatum, Linn. (12 inches high, rooting tips).
A. colpodes, Moore (14 inches high, graceful).
A. cinctum, H. B. K. (15 inches high, drooping).
Asplenium flabellifolium, Cav. (prostrate, rooting tips).
Camptosorus rhizophyllus, Link (Pl. 14).
Davallia membranulosa, Wall. (rhizome of a reddish color).
D. tenuifolia, Swartz (15 inches high, delicate).
D. pallida, Mett. (a beautiful species).
D. platyphylla, Don (a graceful plant).
D. bullata, Wall. (8 inches high, one of the best).
Gleichenia dicarpa, Br. (12 inches high, delicate).
G. dichotoma, Willd. (large and strong).
Polypodium diversifolium, Swartz (curious).
P. lingua, Swartz (stiff, but interesting).
P. percussum, Cav. (fine when in fruit).
P. musæfolium, Blume (very large and fine).
Pteris scaberula, Rich. (very delicate).
The *Selaginellas* also are always useful in this department of fern-culture.

Stumps may be utilized for growing such plants as are denominated *Epiphytic*, and which require but little soil. The Stag's-Horn Ferns (*Platyce-rium*) are well adapted for this mode of culture. The plant of *P. alcinorne* shown in the frontispiece has been growing in the same position, without change or renewal of earth, for six years. The old sterile fronds remain at the base of the plant, and, decaying, furnish a sufficient supply of material for the fern to continue its growth. *P. grande* is un-

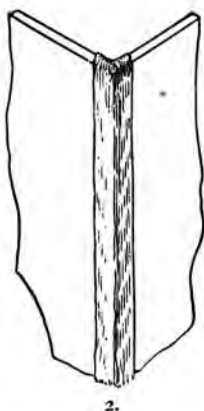
doubtedly the finest of the genus, and is an excellent basket-fern. As soon as the plant is well established, the basket should be inverted, and hung up in this position: therefore, in planting the specimen to be thus treated, care must be taken to have the contents of the basket firm. These ferns are sometimes grown in especially-constructed pots, which may be somewhat scoop-shaped, and made to hang against a wall. *P. alpicorne* will do very well in the living-room. Pl. 20, Fig. 1, is one of these ferns planted on the inner side of a cocoanut-husk, where it grows finely.

A very good way to grow such ferns as *Polypodium vacciniifolium*, when it is not convenient to have whole tree-trunks for them to climb over, is to take the outside slab of a log, and nail to the bottom of this a little shelf, on which may be wired the pot containing the young plant. A slab about three feet long and six inches wide will do. Plants treated in this way will soon attach themselves to the bark by their creeping stems, and, if often sprinkled, will thrive. In the fern-houses of Hon. J. W. Merrill of Cambridge, Mass., are many very pretty arrangements of this sort.

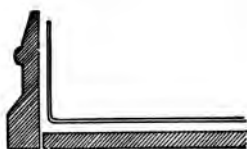
By the term "Climbing-Ferns" we might include various species of *Polypodium* and other genera, which climb by means of their stems; which, as they grow, attach themselves by their fine roots —



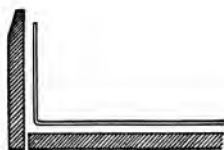
1.



2.



3.



4.

PLATE XV. HOME-MADE FERNERY.

W. & A. G. & S.
LONDON & NEW YORK

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after the fashion of our common English ivy — to the bark, walls, &c., with which they may come in contact. Yet this name has generally been restricted to the species of *Lygodium*, which twine around a support like the smilax (*Myrsiphyllum asparagoides*) or the morning-glory (*Ipomæa*). One of the finest examples of *Lygodium* ever exhibited in Boston was a plant of *L. scandens*, from the collection of Mrs. Durant of Wellesley, Mass. It was in a pot nearly twenty inches in diameter; and had evidently been produced by previously starting several plants in small pots, and then planting them out around the circumference of the larger one. The whole mass of fronds covered a balloon-frame six feet in height. Although with care fine specimens of this genus may be produced, it not unfrequently happens that beginners find the Climbing-Ferns difficult to manage. As for other plants requiring special care, good drainage is the first requisite. The Japanese "Climbing-Fern" (*L. scandens*) is now frequently cultivated in rows by the larger dealers, to be cut and sold fresh for decorative purposes, instead of smilax; but it wilts sooner than the latter, and can never satisfactorily replace it.

The following are some of the climbing species which have been cultivated:—

Lygodium palmatum, Swartz (Eaton's Ferns of N.A., Pl.

- 1). From Massachusetts to Florida. Hardy; needs loose soil; naturally climbs over bushes and weeds.

- L. scandens* (?) (Beddome, Ferns of So. India, Pl. 61). This is the name applied to the species most frequently found in cultivation, and which is certainly one of the most beautiful.
- L. japonicum*, Swartz (Beddome, Ferns of So. India, Pl. 64), is often confused with the last.
- L. dichotomum*, Swartz (Hk. and G., Ic. Fil., Pl. 55), is often united with *L. flexuosum* (Beddome, Ferns of So. India, Pl. 63). The fronds of both these species are large, the pinnæ being often a foot long.





CHAPTER XII.

TREE-FERNS.

TREE-FERNS differ so much in appearance from their humbler relatives, and their cultivation involves so many special cares, that we will give them a chapter to themselves.

In Chapter I. the writer endeavored to show the relation between the stem of the Tree-Fern and that of ferns of lowlier habit. It remains to speak of the difference caused in the growth of the fern by this remarkable form of stem, and to explain why Tree-Ferns demand a peculiar method of cultivation. It is only in a large house that they can be grown at all; for although they always begin with the minute spore, and pass through the *prothallus* stage of development, yet, in their native haunts, they sometimes reach the height of sixty feet from the ground, and have a circle of spreading fronds one hundred feet in circumference.

The trunk of a Tree-Fern is formed by the axis

of growth being continually elevated; thus producing, as it were, internodes between the fronds. It is therefore taller than other fern-stems, for the same reason that a hollyhock is taller than a dandelion, although each develops about the same number of leaves. This trunk, in growing, forms woody tissue very much as do the palms. Woody bundles run down from the fronds into the trunk; but the centre is generally filled with pith. As the old fronds decay they fall off, leaving each a scar on the trunk; and these scars form odd and sometimes graceful markings on the exterior. The roots of the Tree-Fern originate, not at the base of the trunk as with ordinary trees, but at the base of the crown from which the fronds spring, and among the petioles of former fronds. So we see at once the importance of keeping the trunk continually moist, that the new roots may not become dry on their way down to the earth. This also suggests a resemblance between the trunk of the Tree-Fern and the stem of the creeping species; and hence, also, the life of the Tree-Fern is chiefly concentrated about the crown. If these crowns are kept in good order, Tree-Ferns can be transported from their native countries without either fronds or ground attachment, and packed loosely in boxes; enough vitality remaining for them, under careful treatment, to regain their former magnificence in a year or two in their new home.

Another quite important service, though a mechanical one, is performed by the overlapping of roots down the trunks of Tree-Ferns. Unlike our forest-trees, the fern does not increase the size of its trunk, after it has once formed one, below its growing-point; and hence, as the trunk must thus grow larger above, the lower portion of the trunk would be the weaker, and would be liable to snap in a high wind. The overlapping roots furnish the strength required, and enable the plant to develop in safety.

So few Tree-Ferns, in comparison with those brought to Europe, are imported into this country, that it is seldom known among us how easily they may be obtained and transported. In "The Fern Garden," p. 129, Shirley Hibberd tells us how to procure them, and how to treat them afterward: —

"Let us now suppose that some obliging friend in Australia makes you a present of a lot of Tree-Ferns. He has found some specimens with stems from four to five or even six feet long. He has cut away all the fronds, and dug them up, without taking the trouble of saving any of the roots. In fact, they are stems, and nothing more, — stems *sans* fronds, *sans* roots, *sans* every thing. He leaves them out in the air for a few days to dry, and then packs them with shavings in a box. Let him be especially careful that this box be not air-tight: that is their greatest danger. In this way they generally come with pretty good success, a large majority of them quite safely. And now, as we unpack them, let them be placed upright in some close, cool, dark corner: under the stage of a greenhouse is as good a place as they

can have. Give them a syringing once a day for the first week, and after that two or three times a day: never allow them to get quite dry. By the end of a fortnight, or even sooner, you will observe the points of new roots starting out upon the stem, and the closely-coiled-up fronds in the centre to be pushing upwards.

"They may now be safely potted. I have no faith in *exact proportions* for mixing soils; and my candid opinion is, that the mechanical condition of the soil has more influence than any thing else. Let it, then, above all things, be open and porous. Use pots as small as you can, in the first place, and shift them from time to time as the plants may require it, using rough peaty soil as before. If allowed to become pot-bound, the fronds soon dwindle in size. Keep them always moist at the root, and during nine months of the year the stem should be kept constantly moist. This can easily be done without wetting the fronds much, which is not always beneficial. Do not expose your plants to draughts of dry air, and be sure to shade them from bright sunshine. Following these simple rules, your Tree-Ferns will be an ever-increasing source of pleasure."

Smith, in "Ferns, British and Foreign," gives the following suggestions regarding the re-potting of Tree-Ferns:—

"When large ferns are to be re-potted, an inverted pot should be placed in the new pot, placing a layer of drainage around it, the height of the pot to be such that the crocks of the old ball (which must not be taken out) rest on top of the (inverted) pot. By this means the outer circle of new roots are not crushed by the weight of the plant."

If, in cultivation, a Tree-Fern becomes too tall for the house in which it grows, it is possible to re-

duce its height. Select a time when the fronds have attained their full growth, and are dormant: then cut the trunk off, so that, when the upper part is again planted, it will be of the required altitude. By careful tending, the fern will, in a year or two, be in good order again, and ready to continue its growth undisturbed for perhaps twenty years.

Small plants, and occasionally large ones, of many of the choice varieties of arborescent ferns, may be obtained of the larger plant-dealers in this country.

The Tree-Ferns belong to several genera, and have many very near relatives among the low-growing species. Thus the *Dicksonia antarctica* (Pl. 7), one of the largest among the Tree-Ferns, has associated with it in the same genus *D. punctilobula*, one of our commonest native ferns, with a creeping stem, and with the whole plant rarely reaching three feet in height. The *Blechnum Brasiliense* (see frontispiece) has among its congeners species which are seldom more than six inches high.

Williams, in "Select Ferns," gives a list of forty Tree-Ferns which have been successfully grown in the greenhouses of England, so arranged as to show the species which require a temperature averaging 70° Fah. in summer and 42° in winter, and those whose average summer temperature

must be 75° and their winter 65°. As these plants have so much longer been the subjects of experiment in England than in this country, we can do no better than to examine this list, a portion of which is here given. Among the former are

- Alsophila australis*, Br., S. America.
- Alsophila Cooperi*, Hk., Queensland.
- Alsophila excelsa*, Br., Norfolk Island.
- Dicksonia antarctica*, Labill., Australia.
- Dicksonia arborescens*, L'Herit., St. Helena.
- Dicksonia fibrosa*, Col., New Zealand.
- Dicksonia lanata*, Col., New Zealand.
- Dicksonia squarrosa*, Sw., New Zealand.
- Dicksonia* (*Cibotium*) *Barometz*, Link, China.
- Dicksonia* (*Cibotium*) *Menziesii*, Hk., Sandwich Islands.
- Cyathea dealbata*, Sw., New Zealand, &c.
- Cyathea medullaris*, Sw., New Zealand.
- Thyrsopteris elegans*, Kunze, Juan Fernandez.

Among the latter which require the warmer temperature he mentions

- Alsophila aspera*, Br., Tropical America.
- Alsophila procera*, Kaulf., Brazil.
- Alsophila radens*, Kaulf., Brazil.
- Alsophila pruinata*, Kaulf., West Indies.
- Alsophila ferox*, Presl (*aculeata* of some authors), West Indies, &c.
- Alsophila armata*, Presl, Tropical America.
- Alsophila glabra*, Hk. (*gigantea* of some authors), East India.●

PLATE XVI.



ASPLENIUM RUTA-MURARIA, L.
(WALL RUE, SPLEENWORT.)

44

- Cyathea arborea*, Smith, West Indies.
Cyathea canaliculata, Willd., Mauritius.
Cyathea excelsa, Sw., Mauritius.
Cyathea Serra, Willd., West Indies.
Cyathea sinuata, H. and G., Ceylon.
Hemitelia grandifolia, Spr., West Indies.
Hemitelia horrida, Br., West Indies.
Hemitelia Karsteniana, Kaulf., Venezuela.
Hemitelia speciosa, Hk., Tropical America.

As very few plates give much more than the botanical characters of the species, no references to figures are given for species of Tree-Ferns.

Blechnum Brasiliense, illustrated in the frontispiece, is an excellent fern for a small house. Although old plants form quite tall stems, it is rarely seen more than six feet high. *Lomaria gibba* and *L. ciliata* are very beautiful ferns. They form small stems one to two feet high, and spread fifteen to thirty inches across the top. They are likely to be attacked by *thrips* if kept in too warm a place.





CHAPTER XIII.

GOOD FERNS FOR CULTIVATION.

THIS chapter contains lists of ferns suitable for cultivation in the tropical and temperate houses and the fern-case. References to published figures, and brief hints at the character of these ferns, are added. The size of the plants is also given, that selections may be made for fern-cases, according to their dimensions or the owner's fancy. It is, however, to be noted, that no hard-and-fast line can always be drawn between plants for the two houses, as many species will flourish in either.

Good Ferns for the Tropical House.

Adiantum amabile, Hort. (Gardener's Chronicle, 1868).

Seems to be *A. Moorei*, Baker, S. America. Fr. 10-20 inches long.

A. caudatum, Linn. (Hk., Fil. Ex., Pl. 104). Fr. 8-18 inches long, 1-2 inches broad, often rooting at the tip.

A. concinnum, H. B. K. (Lowe, B. and E. Ferns, vol. iii., Pl. 1). Tropical America. Fr. 12-20 inches long, 6-9 inches

broad. Another form of this beautiful fern is the *var. latum*.

A. Farleyense, Hort., "appears to be an abnormal form of *A. tenerum*, Sw., of garden origin." It is undoubtedly, when well grown, one of the most magnificent of *Adiantums*, perhaps of any of the lower-growing ferns. It never bears fruit. Mr. Such, of South Amboy, N.J., had in 1875 plants of this fern three feet in diameter.

A. macrophyllum, Sw. (Hk., Fil. Ex., Pl. 55, and H. and G., Pl. 132). Fr. 12-30 inches long, 4-8 inches broad. The segments are large, and the color of the young fronds is a beautiful pink.

A. Peruvianum, Klotzsch (Hk., Sp. Fil., vol. ii., Pl. 81, C). Fr. and segments large.

A. Sanctæ Catharinæ, Hort., does not very much differ from *A. trapeziforme*, Linn., of which it is a variety.

A. velutinum, Moore (Gard. Chron., 1866). Fr. 18-24 inches long, 10-15 inches broad. A fine fern.

Angiopteris evecta Hoffm. (H. and G., Pl. 36, and Hk., Fil. Ex., Pl. 75). A very interesting but large and coarse fern, belonging to the sub-order *Marattiaceæ* of Hk., plants of which order are, on account of their peculiar mode of fruiting and growth, considered by Sachs as pseudo-ferns.

Asplenium Belangeri, Kunze (Beddome, Ferns of British India, Pl. 287). Malayan Peninsula, &c. Fr. 12-18 inches long, erect, graceful.

A. cicutarium, Sw. (Lowe, vol. v., Pl. 20). Tropical America. Fr. 12-18 inches long, 4-6 broad. A delicate and beautiful fern.

A. formosum, Willd. (Hk., Fil. Ex., Pl. 16). Tropical America. A delicate fern, with fr. 6-12 inches long, and 1 inch broad.

A. Zeylanicum, Hk. (Hk., 2d Cent. of F., Pl. 16). Fr. 6-12

inches long, 1-2 inches broad. A fine-growing species for a large pan.

A. nidus, L., has several names (Hk., Fil. Ex., Pl. 88, under *A. australasicum*, Hk.). South tropics. A noble fern, with simple fronds, which, when well grown, are sometimes 6 feet long. The plant resembles an *Agave*.

A. flaccidum, Forst. (Lowe, vol. v., Pl. 19). New Zealand. Fr. 1-3 feet long, 6-12 inches broad. Graceful, drooping.

A. flabellifolium, Cav. (Hk., Ex. Flo., vol. iii., Pl. 208). A delicate, prostrate species. Fr. 1 foot long, 1 inch broad, rooting at the tip.

Aspidium laserpitifolium, Mett. (Beddome, F. S. I., Pl. 225). Japan and India. Fr. 12-18 inches long, 6-9 inches broad. A very interesting species.

Acrostichum aureum, L. (Beddome's F. S. I., Pl. 204). The plant resembles a salix of young and rapid growth. When placed in a pan or tub of water, the fronds will become 6 feet long.

A. crinitum, L. (Hk., Fil. Ex., Pl. 6). A strange-looking plant, resembling a *Begonia* more than a fern. Fr. simple, 6-12 inches long, 6 inches broad, very thickly covered with glandular hairs.

Blechnum Lanceola, Sw. (Hk., 1st Cent. F., Pl. 70). Tropical America. Fr. 2-12 inches long, $\frac{1}{2}$ -1 inch broad.

Davallia dissecta, J. Sm. (Moore, Gard. Chron., 1855). Java. Fr. 12-18 inches long, 8-10 inches broad. Delicate.

D. platyphylla, Don (Hk., Fil. Ex., Pl. 19). Fr. 1-3 feet long, 1 foot broad.

D. pedata, Smith (Hk., Sp. Fil., vol. i., Pl. 54). Japan, &c. Fr. 2-6 inches long, 1-2 inches broad.

Gleichenia dichotoma, Willd. (Beddome's F. S. I., Pl. 74). Fr. forking, almost climbing. A good plant for a large basket. Not very graceful. Others of the genus are cultivated, but are quite difficult to manage.

- Lomaria fluviatilis*, Spreng. A spreading fern. Fr. 6-18 inches long, 2 inches broad.
- Meniscium simplex*, Hk. (Hk., Fil. Ex., Pl. 83). Fr. 6-9 inches long, 2-3 broad, simple. A curious fern.
- Nephrolepis exaltata*, Schott (Eaton's Ferns of N. A., to be figured). A native of Florida; grows pendent from old trees. Very beautiful.
- N. davallioides*, var. *furcans*, Hort. A beautiful fern, resembling the last. Each of the pinnæ are forked. There is a fine specimen at the Botanic Gardens in Cambridge, Mass.
- Oleandra neriiformis*, Cav. (Hk., Fil. Ex., Pl. 58). Many species in cultivation are probably forms of this. Fr. 6-18 inches long, 1 inch broad.
- Polypodium musæfolium*, Blume (Beddome, F. B. I., Pl. 317). Fr. 1-3 feet long, 2-4 inches broad. A fine fern for large pans or baskets. The veins are much reticulated.
- P. aureum*, L. (Eaton's Ferns of N. A., to be figured). A large fern, with the fruiting very conspicuous.
- P. conjugatum*, Lam. (Hk., Fil. Ex., Pl. 91). Fr. 2-4 feet long, 1 foot broad, from a very thick caudex, and curiously winged at the base.
- P. irioides*, Lam. (Hk., Fil. Ex., Pl. 4). Fr. 1-3 feet long, 1-3 inches broad, very leathery. The plant resembles *Phyllocactus latifrons*.
- P. pectinatum*, L. (Hk., Gard. F., Pl. 10). Fr. 12-30 inches long, 1-3 inches broad. Resembles somewhat the next.
- P. plumula*, H. B. K. (Eaton's Ferns of N. A., to be figured). Hooker considers this a form of *P. taxifolium*, L.
- Pteris palmata*, Willd. (Hk., Gard. F., Pl. 22), has several names, among which are *Doryopteris palmata*, *Pteris pedatoides*, &c. The fronds are, as the name signifies, palmately divided. Stalks one foot high.

Pt. tricolor, Hort. (Bot. Mag., Pl. 5, 183), (Lowe, vol. ix., N. and R. F., Pl. 9, under *Pt. aspericaulis*, var. *tricolor*), and *Pt. argyrea*, Hort. (Lowe, vol. ix., N. and R. F., Pl. 10), are varieties of *Pt. quadriaurita*, Retz. The latter is a very fine large-growing plant; the former, smaller, and much more difficult to manage.

Good Ferns for the Temperate House.

- Adiantum Æthiopicum*, L. (Hk., Sp. Fil., vol. ii., Pl. 77, A). Fr. 12-18 inches long. A graceful, delicate fern, particularly good for baskets. *A. assimile*, Sw. (Lowe, vol. iii., Pl. 8), is probably a var. of this species.
- A. affine*, Willd. (Lowe, vol. iii., Pl. 7), New Zealand only. A very pretty low-growing species. Another form is *A. Cunninghami*, Hk. (Hk., Sp. Fil., vol. ii., Pl. 86, A).
- A. Capillus-Veneris*, L., figured in every work on British ferns, and native of Europe and the Southern United States, is another charming low fern.
- A. Chilense*, Klf. (Eaton's Ferns of N. A., *to be figured*), of California, Hooker considers to be only a var. of *A. Æthiopicum*, L. It seems, however, in cultivation, to resemble more generally the preceding species.
- A. colpodes*, Moore (Gard. Chron., 1865), resembles *A. concinnum*, H. B. K. Fr. 12-18 inches long.
- A. cuneatum*, L. and F. (H and G., Pl. 30).
- A. formosum*, R. Br. (Hk., Sp. Fil., vol. ii., Pl. 86, B). Australia, &c. Fronds raised on long stalks, resembling somewhat *A. pedatum*, L.
- A. hispidulum*, Sw. (Lowe, vol. iii., Pl. 9, under the name of *A. pubescens*, Schkuhr). Asia. Habit of *A. formosum*, R. Br.
- A. fulvum*, Raoul (Lowe, vol. iii., Pl. 19, Hk., Sp. Fil., Pl. 85, A). Resembles last, but smaller. Young fronds a reddish color.

- A. reniforme*, L. (Hk., Sp. Fil., vol. ii., Pl. 71, A; and Hk., Fil. Ex., Pl. 8). A curious fern, the fronds being kidney-shaped, with a stalk 3-6 inches long.
- Aneimia adiantifolia*, Sw. (Eaton's Ferns of N. A., Pl. 14). Florida, &c. This and the next have fronds 10-15 inches long, the fertile segments being raised on separate stalks from the base of the fronds.
- A. Phyllitidis*, Sw. (Lowe, vol. viii., Pl. 71). Resembles *A. Mexicana*, Klotzsch (fig. Eaton's Ferns of N. A., Pl. 14), but the veins anastomose in the former, while in the latter they are free.
- Asplenium alternans*, Wall. (Beddome, F. B. I., Pl. 59). Fr. 6-12 inches long, 1-2 inches broad.
- A. bulbiferum*, Forst. (Beddome, F. B. I., Pl. 65). Fr. 12-30 inches long, 6-12 inches broad. Graceful, bearing little plants all over the upper portion of the fronds.
- A. monanthemum*, L. (*A. Menziesii*, H. and G., Pl. 100). Fr. 12-18 inches long, 1 inch broad.
- A. resectum*, Smith (H. and G., Pl. 114). Fr. 8-12 inches long, 2-4 inches broad.
- A. goringianum pictum*, Hort., is probably a var. of *A. macrocarpum*, Blume. The fronds resemble *Aspidium spinulosum* somewhat, and are variegated. A very pretty fern.
- Blechnum occidentale*, L. (Lowe, vol. iv., Pl. 39). Fr. 8-12 inches long, 1-2 inches broad.
- B. unilaterale*, Willd. (Lowe, vol. iv., Pl. 34, under *B. polypodioides*), resembles the last.
- Aspidium falcatum*, Sw. (Hk., Fil. Ex., Pl. 92), Japan, &c., *Cyrtomium falcatum*, *A. caryotideum*, and *A. Fortunei*, are different names for forms of this fern. Fr. 12-30 inches long, 4-8 inches broad, segments large, upper portion a glossy green. This species is sometimes cultivated out of doors in England.

- Davallia bullata*, Wall. (Hk., Sp. Fil., vol. i., Pl. 50). Fr. 4-8 inches long, 3-4 inches broad, much cut. An admirable basket-fern, and is figured in Pl. 20 of this book.
- D. Canariensis*, Smith (Hk., Sp. Fil., vol. i., Pl. 56). Fr. triangular, much cut, darker green than last. This is sometimes called the Hare's-Foot Fern. In Shirley Hibberd's "Fern Garden," p. 109, there is an excellent figure of a plant of this species.
- D. Mooreana*, Hort. (Gard. Chron., 1855). Probably a var. of *D. pallida*, Mett. Fr. 2-3 feet long, 1 foot broad, very delicate and drooping, light green. An excellent exhibition fern.
- D. tenuifolia*, Sw. (Beddome, F. S. I., Pl. 16). Fr. 12-20 inches long, 6 inches broad, much cut.
- Doodia aspera*, R. Br. (Lowe, vol. iv., Pl. 30). Fr. 8-12 inches long, 1-2 inches broad, rigid.
- D. caudata*, R. Br. (Lowe, vol. iv., Pl. 31). Fr. narrower than the last; habit similar.
- Lomaria ciliata*, Labill. (Gard. Chron., 1866), and *L. gibba*, Labill. (see frontispiece), are little Tree-Ferns, having stems a foot high, surmounted by a crown of fronds eighteen inches in diameter. Both are easily cultivated, and are desirable ferns.
- Mohria caffrorum*, Desv. (Lowe, vol. ix., N. and R. F., Pl. 42, under *M. thurifraga*, var. *achillæfolia*). Fr. very much cut. A very pretty plant.
- Nephrodium decompositum* (*Aspid. acuminatum*, Lowe, vol. vi., Pl. 11), *R. Br.* Australia, &c. Fr. 18-30 inches long, 6-12 inches broad.
- N. unitum*, *R. Br.* (Eaton's Ferns of N. A., Pl. 13, under *Aspidium unitum*, var. *glabrum*). Fr. 1-3 feet long, 6-10 inches broad.
- N. molle*, Desv. (Beddome, F. S. I., Pl. 84). Fr. 1-3 feet long, 6-8 inches broad. Common in greenhouse culture.



PLATE XVII. FERNERY, WITH BASE OF BLACK STONEWARE.

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- N. patens*, Desv. (Eaton's Ferns of N. A., to be figured), resembles the last.
- N. setigerum*, Baker (Hk., Sp. Fil., vol. iv., Pl. 269, under *N. tenericaule*). A very rank-growing fern, with delicate fronds two feet or more long.
- Onychium Japonicum*, Kunze (Beddome, F. B. I., Pl. 21, under *O. lucidum*, Spr.). A very finely-cut fern, with fr. 1-2 feet long, 6 inches broad.
- Pellaea andromedæfolia*, Fée (Eaton's Ferns of N. A., to be figured). Although difficult at first to manage, this will in time make a very handsome plant.
- P. hastata*, Link (Hk., Fil. Ex., Pl. 50). Fr. 1-2 feet long, 6-10 inches broad. Dark green, with black stalks. Several varieties of this species are in cultivation.
- P. intramarginalis*, J. Smith (Hk., 2d Cent. F., Pl. 62, under another name). Fr. 8-15 inches long, 2-4 inches broad.
- P. tenuifolia*, Fée (Hk., Fil. Ex., Pl. 15). Resembles last in habit, but not in cutting.
- P. rotundifolia*, Hk. (Hk., Fil. Ex., Pl. 48). Fr. 1-2 feet long, 1 inch broad, with pinnæ circular. Dark green.
- Pteris scaberula*, Richard (Hk., Sp. Fil., vol. ii., Pl. 93, A), New Zealand. Fr. 8-12 inches long, 3-6 inches broad, very finely cut. A most charming fern. Should be planted in a shallow pan.
- Pt. serrulata*, L. (Lowe, vol. iii., Pl. 40). One of the commonest ferns in cultivation, a weed in many greenhouses, yet very pretty.
- Pt. tremula*, R. Br. (Hk., Sp. Fil., vol. ii., Pl. 120, B). Fr. 1-3 feet long, 1 foot broad. A handsome species.
- Pt. Cretica*, var. *albo-lineata*, Hort. (Lowe, vol. ix., N. and R. F., Pl. 25). Fr. 1 foot or more long, divided into ribbon-like pinnæ which have a white stripe in the centre.
- Pt. semipinnata*, L. (Hk., Gard. F., Pl. 59). Fr. 15-20 inches long, 6-9 inches broad. An erect species.

Polypodium subauriculatum, Blume (Beddome, F. B. I., Pl. 78). A large-growing species.

Woodwardia Japonica, Sw.; *W. radicans*, Smith; *W. orientalis*, Sw.,—are all fine large ferns, and very beautiful in cultivation. *W. radicans* will be figured in Eaton's "Ferns of North America."





CHAPTER XIV.

HOW TO PROPAGATE FERNS.

IN this chapter we are to consider how to multiply our ferns. It may be done in three different ways, — (*a*) by growing them from spores, (*b*) by dividing the larger plants, (*c*) by propagating the buds, which, as we have previously seen, are formed upon certain species. If we are so fortunate as to possess a greenhouse, or, still better, if a friend will allow us a corner of his, we can produce ferns to our heart's content; but, if we depend upon our window or out-door garden, we shall be likely to fall short of the success which a greenhouse will insure.

In the chapter on Structure it was mentioned that the fronds of many species of ferns spring from underground stems which creep about either directly upon the surface or at some distance beneath it, and that the roots were produced directly from this stem also. Now, supposing

that we have a plant of this habit, — a *Polypodium* or *Pteris*, for instance, — all that it is necessary to do to make two or more plants of the one is to divide this stem, between the buds or fronds on it, into as many parts as we desire new ferns. We remove it from the pot if it is a greenhouse specimen, or scrape the earth from around it if it is planted out, and observe where these underground stems are, and how the fronds which spring from them are grouped. With a moderately sharp knife we may now cut the stems, without disturbing the earth about the plant any more than is absolutely necessary, tearing apart with our hands the uncut remainder of the roots. We put each part of the plant thus divided into a pot just large enough to hold it easily, and press the earth in firmly around it, having previously placed in the bottom of the pot the necessary drainage material. For a week or ten days the newly-separated plants should be kept moist, not wet, and in a quiet shade: if out of doors, protected by a frame and sash, and somewhat shaded; if in the greenhouse, in some shady corner. A case not intended for a fernery, capable of being closed and yet sufficiently light, 3 by 2 feet, and 18 inches high, is a very handy thing for in or out door use at this time. When we think that our plants have sufficiently recovered from the shock of being thus torn asunder, they may be placed with the

other ferns in the collection. If the fern to be divided is one of the hardy species in the out-door fernery, this process should not be attempted except during the resting period, either early in the spring, or late in the fall. The former time is to be preferred. Indeed, it is never judicious to meddle with plants when actually growing; although, even at such times, a "shift" or division may be compulsory. It must always be managed with great care.

Other ferns, as *Adiantum*, *Struthiopteris*, and *Woodwardia*, have underground stems, but produce their fronds in little tufts at the ends of these. In *Adiantum* the stems do not wander far, and may be easily discovered by removing for examination almost any species of this genus from its pot when it seems to be ready for removal to a larger one. The stems are lighter in color than the roots, and have a few fronds coiled up closely at their ends. It is this habit which renders the *Adiantum* so desirable for a basket-fern, particularly for the cocoanut-shell referred to elsewhere. In the case of the Ostrich Fern (*Struthiopteris*), these underground stems are always a source of great astonishment. They frequently creep away to a distance of four or five feet before re-appearing, and then quietly throw up their vase-like forms where they are, perhaps, least expected. A plant in the writer's collection made its way under

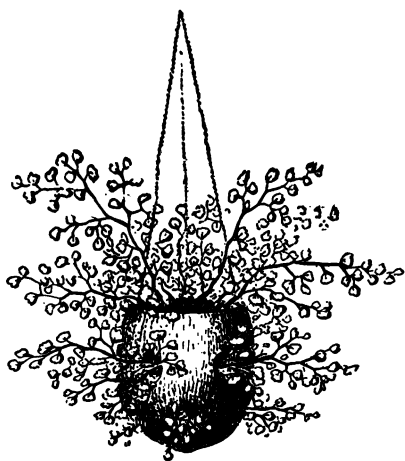
a tight board fence, and delighted a neighbor, who, thinking it something planted and forgotten, could not recall to mind where she had obtained so charming a fern. Ferns of the habit of the *Struthiopteris* are readily removed at almost any time. The principal roots are near the crown, which can be dug up with a ball of earth around it, and cut free of the long running stem.

Of course it will be seen that it will be useless to divide any of those ferns which, like most *Aspidiums* and Tree-Ferns, produce their fronds from a single crown, and do not form underground stems. To increase our number of these, we must depend upon raising the plants from spores. Yet many species, which apparently spring thus from crowns, are in the habit of increasing the number of these crowns around the first. This is only another form of the underground stem, although here it is extremely short. Plants of this description, *Scolopendrium vulgare*, some *Aspidiums* and *Aspleniums*, and the smaller *Blechnums*, may be laid down on their sides, cut through with the trowel or knife, and treated as before recommended. Some ferns move away from the place at which they started, as does our common garden Solomon's-seal, by the stem of the last year decaying as the new stem grows forward. Potted ferns of this habit will in a few years be found on one side of the pot; or perhaps, if in a very large pot, the fronds will

be flourishing around the edge, while the centre is left empty. With greenhouse ferns, careful re-potting will remedy this; but in the case of the out-door plants, as *Onoclea*, it is best to let them have their own way. One curious fact comes to the observation of every one who has much to do with growing ferns, and the same is noticed by several authors, — the ferns which are most readily increased by stem-division are not freely produced from spores, while the ferns most easily raised from spores can seldom be divided when fully grown. There are exceptions, of course, to this statement; but its general truthfulness is very apparent to all fern-cultivators.

It is very easy to raise ferns from buds. A portion of a frond of *Asplenium bulbiferum*, or any fern on which the little plants have made their appearance, may be fastened down upon a pan of firm porous soil, and a little sand — not enough to cover the bulbs — be sifted over it. It should be protected by a glass: a pane of common window-glass laid over the pot will do, if sufficient space has been left, as it should be, when filling the pan, to allow the little ferns to develop two or three fronds. In the course of a few weeks the plants will probably have rooted, and may be separated by cutting the old frond into pieces wherever a bud has started, and putting each piece into a small pot by itself.

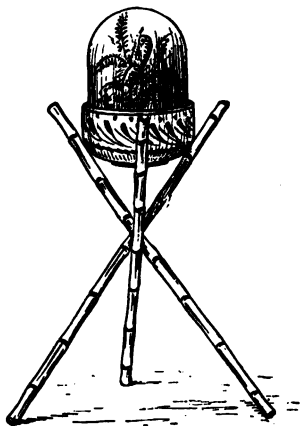
A great many methods are given for raising ferns from spores. Of course the spores of all species requiring tropical heat must be kept in the propagating-house, or in some place where the pans in which the spores have been planted will receive bottom heat or its equivalent. The spores may be sifted on the earth directly from the fronds, or from papers on which they may previously have been collected. It is generally desirable that they should be fresh, although the spores of many species are supposed to retain their vitality for a long time. M. C. Cooke, in his "Fern-Book for Everybody," states that "a lady friend prefers for cultivation spores two or three years old, as she thinks they germinate better." This is a very strange statement, and is not found to be generally confirmed by writers on this subject. Whether the spores are sown in the greenhouse, tropical house, or in frames out of doors, the soil should be quite firm, well drained, and have more or less of the smaller bits of the broken pots used for drainage mixed with the upper earth. The pots, pans, boxes, or whatever receptacles are to serve as nurseries for the sporelings, need not be very deep, as only about one inch of soil will be required. The remainder of the space should be well filled with fragments of broken pots for drainage. The soil should be equal parts of fine peat or meadow-mould, and fine sand. When this is arranged, and



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PLATE XVIII.

1. Coconut-basket.

2. Japanese stand.

3. Russian stand.



the earth watered, the spores may be sprinkled over the surface. The whole should then be covered with a bell-glass (Pl. 8, Fig. 1), or, if there should be room for the young plants, with a pane of window-glass (Pl. 8, Fig. 2). Some large cultivators prefer to have the pans placed in a special case, with a sash to close it within a few inches of the pans; thus saving the trouble of removing so many glasses when examining the young plants.

For the hardy species, a frame out of doors, in summer, will answer very well; but, as it is much easier to obtain plants already grown from the fields and woods, it will seldom be worth the while to raise any such species from spores.

The pans must be kept moist, but never watered from the top, as this will surely wash away the spores. The best way is to stand the pans in a shallow dish of water, and allow the supply to be drawn up as required.

Smith states that the spores of some ferns will not germinate till eighteen months after they are sown, while those of some species of *Gymno-gramme* and *Cheilanthes* appear in a few days. In due time, generally a few weeks after the sowing of the spores, the *prothalli* of the future ferns may be seen, covering the earth, as it were, with a green mould. In a short time the true fronds will be developed. Some ferns grow very rapidly, — *Aspidium molle*, for example, making plants twelve

inches high, in eight months, from the spores; but, as a general rule, it will be two or three years before ferns so grown will require an eight-inch pot. In a moist greenhouse where many ferns are cultivated, the spores, as they ripen upon the fronds and are discharged into the air, are likely to fall upon the surface of the pots in which other plants are growing, or upon the shelves, benches, walls, or floor of the house. One of the most interesting things connected with fern-culture is the pleasure derived from watching these waifs as they develop; yet with it come the usual vexations which follow plant-cultivation everywhere. These same spores, which germinate so freely when chance-sown, are sure to intrude themselves where we have prepared with special care a pan to cultivate some choice species of fern, of which we have obtained the precious seed. In this way it happens often that plants of *Gymnogramme chrysophylla* and *Pteris serrulata* will occupy such a pan, and crowd out every thing else; and, as all the young plants are to the inexperienced eye very much alike, to try weeding out the intruders may result in the summary destruction of the choicer ferns.

In growing ferns from spores, the directions regarding boiling or baking the soil should be more strictly observed than in any other department of fern-culture; as we soon realize the im-

portance of having our pans, in which spores are to be sown, absolutely free from all other germs of plant or insect life. A very neat way of raising sporelings is recommended by Mr. M. C. Cooke, who states that it is derived from German botanists. A piece of firm peat a few inches high is soaked in boiling water to kill any life that may be in it, and, when cool, placed on end in a saucer. On this the spores are sown, and a bell-glass placed over it. Water can be supplied by pouring it into the saucer as it is absorbed by the block of peat. To raise *prothalli* for microscopic examination, bits of broken pots, on whose moistened surfaces the spores are encouraged to germinate, will be found excellent, as the *prothalli* can be scraped away unmixed with particles of earth, and be brought clean to the lens.

In English greenhouses several ferns have been known to appear, whose origin it is impossible even to conjecture. *Lomaria Patersoni*, a Tasmanian species, sprang up at Kew in 1830, and *Doodia blechnoides* in 1835; and of these species it was supposed that not a single example was in cultivation in England, and that of the former only one herbarium specimen—the only one in the kingdom—was safely packed away in the British Museum. *Nephrodium setigerum* appeared in the greenhouse of a gentleman in Salem, when it was known that there was not a plant of that species

within twenty miles; and the writer has a fine specimen of *Asplenium pinnatifidum* which grew in a pan of *Trichomanes Petersii*, the plants in which came by mail from Alabama, and had been growing a year before the *Asplenium* made its appearance. Of course packing-material, or, indeed, the leaves of plants received by any means of transportation, doubtless contain invisibly the spores of many ferns new to the region to which the plants are sent.





CHAPTER XV.

OTHER CRYPTOGRAMS IN CULTIVATION.

THE structure and cultivation of ferns alone have thus far been discussed, except that in Chapter II. sufficient mention has been made of other plants to indicate the place of ferns in a general system of classification. Even now we can only speak briefly of such other Cryptogams as are or may be cultivated, dismissing with a word the rest which cannot be taken from their native habitats.

If we turn to the table at p. 53 we may commence with the lowest groups, and follow up the arrangement to the *Lycopods*, the highest of all cryptogamous plants.

The *Algæ* are a very important family in nature, but, outside of a few aquaria, are seldom met with in cultivation. The smaller marine species are much sought for to arrange in collections of taste and to study scientifically; and the *Diatoms*, among the humblest of plants, are the subject of profound

investigation by microscopists, who use their silicious cases as test-objects for high-power objectives.

The parallel group of *Fungi* is generally very uninteresting as presenting objects for collection, although much investigated by patient scientists. Many species among the larger ones are edible; and the mushroom (*Agaricus campestris*) is frequently seen at horticultural exhibitions, though it is seldom that this excellent vegetable reaches the suburban markets. Old specimens of *Polyporus*, the shelf-like, woody fungus which grows upon old trees, may be easily converted into a bracket upon which to place a pot-plant or a vase.

The *Lichens* are very tempting to collectors, in the hope that they may be made to flourish in the fernery; but they soon mould, and spread trouble among the ferns. One of the most beautiful, the *Evernia vulpina* of California, is a fine object to use for house decoration in company with the *Tillandsia*, and, like most of the pendent *Lichens*, may be washed when dusty.

Of the *Characeæ* many species may be found in ponds and rivers, sometimes growing in quite deep, but more frequently in shallow water. Some have a very unpleasant smell, resembling sulphuretted hydrogen, when first collected; and some are covered by a deposit of carbonate or phosphate of lime, which is secreted by the plant, and hence

considered by botanists as analogous to the silicious particles in the stem of *Equisetum*. The *Charas* and *Nitellas* may be kept a long time in water with a little earth at the bottom, and are very interesting. Their large cells, under the microscope, are excellent objects to illustrate the rotation or circulation of the protoplasm. *Charas* are reproduced in two ways, — by an oosphere after fertilization, or by bulblets analogous to the buds of other plants. Charles Johnson, Esq., in "Ferns of Great Britain," London, 1859 (almost the only English work illustrating the common species of *Chara* and *Nitella*), says, "Young plants may be easily raised of all the species." He had grown many, especially *C. aspera*, himself. Later works than this, however, should be consulted for the structure and development of these plants.

Among the *Hepaticæ* the *Marchantia* is very interesting in cultivation; and on the trunks of trees, and creeping over rocks, will be found many species of *Frullania*, *Fungermannia*, *Madotheca*, *Ptilidium*, &c., many of them in appearance resembling the *Lichens*, for which they are often mistaken by young botanists. Of course these plants only come into our collection as accessories to the ferns; but they will repay our attention and care.

Of the growth and development of the *Mosses* much might be said. In the out-door fernery they

are useful to assist in keeping moist the earth about the ferns, and to hide the bare surfaces of rocks. For the fern-case they are not to be strongly recommended: they harbor insects which will devour the young fern-fronds as they unroll. But in the open fernery, or out of doors, they can be made of inestimable service, and add much to the appearance of the collection. If grown by themselves during the winter in a shallow glazed case, they are very interesting. The writer once had a mossery instead of a fernery; and with care taken to keep it cool, and give it enough ventilation, the plants were in excellent condition the season through, both growing well, and fruiting. Many of the larger species of *Hypnum* are beautiful, and the close-growing species of the same genus are valuable for a lining to hold the earth in place in the wire baskets for hanging plants. The *Polytrichums* and *Dicranums* of the larger mosses, and *Bryums*, *Mniums*, and *Atrichums* of the small ones, can be used in the out-door fernery among the rocks and ferns. The *Sphagnum* (bog-moss) is always in demand with the gardener, on account of its usefulness in packing plants for transportation, and the many ways in which he can turn its spongy structure to account in his business. A very pretty fashion of European origin has recently come to prevail at horticultural exhibitions in Boston. Instead of



BOTRYCHIUM
LUNARIA, SWARTZ



BOTRYCHIUM BOREALE, MILDE.



displaying choice roses, rhododendrons, &c., in bottles inserted in wooden frames, cases are prepared four feet by eighteen inches, with a depth of eight inches at the back, and four in front. The whole surface being evenly covered with moss, a certain number of tin cups are sunk in it, and hidden beneath the moss; and in these the flowers are arranged with an effect impossible to attain with the old wooden stands.

This brings us, in the table, to the ferns; and, passing them, we ascend the scale above.

Among the *Equisetums*, the common species, *E. arvense*, may be successfully cultivated in moist soil. The finest of all is the "Wood Horse-Tail," *E. sylvaticum*. Shirley Hibberd, in "The Fern Garden," speaks most enthusiastically of this species: "If the reader can imagine a nine-inch pot with about fifty of these stems crowded together in it, all of them arching over with exquisite grace like the feathers from the tails of birds-of-paradise, the color the most tender shade of emerald green, no apology will be needed for calling attention to it in these pages; for it is, in fact, one of the most desirable plants for the fern garden." With us this species is common at the North, and is certainly a most graceful plant. Another, the "Scouring Rush," *E. hyemale*, is an attractive and curious example, growing in situations similar to those chosen by *Pteris aquilina*.

In Chapter II. it was noted that the *Ophioglossaceæ* had been found so to differ from the true ferns, that they were now placed apart from these, and considered only as fern allies. Of these forms, *O. vulgatum* can seldom be kept under cultivation longer than two years. Of the Southern *Ophioglossums* little or nothing can be said. *Botrychium Virginianum* is by far the most graceful of all, and the most easily cultivated. The fronds of this perfect themselves in June, while the various forms of *B. ternatum* do not appear at all till August. The *Botrychiums* require a deep, firm soil, and do not bear disturbance very well. They usually grow in damp places; but varieties of *B. ternatum* and some of the smaller species are frequently found on high pasture-land. Little can be said of the minor forms; but probably they cannot be cultivated with much success.

Among the *Rhizocarps*, *Marsilea quadrifolia* is frequent in cultivation near Boston. It is a pretty little plant, growing in rather shallow water. The leaves, which resemble those of an *Oxalis*, float upon the surface, while the large spore-cases are borne along the creeping stems at the bottom. The plant spreads so rapidly, that, in ponds where it has been growing but a few years, it has every appearance of being indigenous. The habitat given for it in this country is Bantam Lake, Litchfield, Conn.; but the characteristics of its growth

are such, that it may be an introduced species even there.

The *Lycopodiaceæ* are highest among Cryptogams. The order contains the genera *Isoëtes*, *Psilotum*, *Tmesipteris*, *Lycopodium*, *Selaginella*, and *Phylloglossum*. Even a superficial examination of them will suggest resemblances to plants of higher structure among the Phanerogams. Some of the *Lycopodiums* remind us of a pine-tree, and the fruit-spikes of many resemble pinecones. Humble as they now are, they can boast of noble ancestors among the *Lepidodendrons* of geologic antiquity, whose towering stems during the Carboniferous Period reached a height of sixty feet, and which were plants closely connected by the *Sigillarias* to the *Conifers*. We have in America *Psilotum*, a plant which grows in Florida, and resembles the beech-drops (*Epiphegus Virginiana*); and *Isoëtes*, which is an uninteresting grass-like plant growing in shallow water, and having its spores at the bases of the leaves.

The species of the genus *Lycopodium* are difficult to establish in cultivation; and so many writers allude to this fact, that it must have been proved by multiplied and fruitless experiments everywhere among horticulturists. Of our common species, *L. dendroideum*, *complanatum*, *lucidulum*, and *annotinum* are beautiful plants, and much in demand for use as evergreens in all kinds of decoration.

The genus *Selaginella* is, of all the *Lycopods*, most frequently met with in cultivation ; and more frequently, indeed, than all the other Cryptogams, except the ferns. Its graceful habit, and the ease with which its species are grown, at once recommend it to every one for the Wardian-case, greenhouse, or stove. Some *Selaginellas* will thrive in the air of an ordinary living-room. Even in New England two of the smaller species are indigenous, while in California and the South-western States the number of hardy species is much increased. So important are they among cultivated Cryptogams, that we shall devote an entire chapter to their consideration.





CHAPTER XVI.

SELAGINELLAS.

AMONG the *Selaginellas* are plants of very different type, from the solid, carpet-like *S. densa*, to the extensively climbing *S. lævigata*. Between these extremes are such as *S. Martensii*, one of the commonest in cultivation, which rises six or eight inches, dropping roots from the stem to support itself as it grows; and the frond-like species, which have a very fern-like aspect, and are perhaps more delicately cut than any fern. Among these last are *S. viticulosa* and *S. pubescens*. The fern-like *Selaginellas* increase by underground stems, and are, therefore, more difficult to propagate.

Selaginellas all thrive in the tropical, and many species do well in the temperate house. They endure, in fact like, deep shade. Hence they are invaluable for in-door ferneries. The low-growing species, as *S. denticulata*, the commonest of all, make in a wonderfully short time a green carpet

in the fern-house wherever they are allowed to grow, whether on sand or on earth. It has been the writer's practice to allow this pretty *Selaginella* to take its own course, and to cover all the spaces between the pots on the sanded shelves, the earth among the larger pots in a central bed, and whatever space it might find on the greenhouse paths. The professional gardener would doubtless think this a "weedy" proceeding: but we do not all care to see the unrelieved primness of a too well-ordered house; and besides, those of us who have but a small place at best prefer to keep it, as it were, as a large fern-case which we can enter and examine, rather than to arrange it more exactly as a collection, and provoke the comparison of its minuteness to the magnificent establishments of our wealthy neighbors.

Selaginellas may be divided, or their cuttings rooted, at any time. Many species will be found to come up freely from the spores in spring and fall. The fruit-spike, bearing its two kinds of spores, may be discovered at the tips of the little branches on the older fronds. They are of the same green color as the ordinary divisions of the frond, only more dense and angular. Figures illustrating the fruiting and reproduction of *Selaginellas* may be referred to at p. 400 of Sachs's "Text-Book of Botany," and p. 90 in LeMaout and Decaisne's large work mentioned in Chapter IV.

With nearly every species it is best to renew the plants annually, as a year suffices to render them irregular and misshapen. The climbing *Selaginellas* and those from a creeping stem may be put in larger pots, however, as they increase. As most of them do not root deeply in the earth, a shallow soil is enough; but the drainage of the pans must be provided for most carefully. Of the dense-growing species little tufts may be taken, and distributed over the surface of the soil, which should be light and quite sandy, then pressed in slightly, carefully sprinkled, and placed one side in a moist and shady corner. Of the taller-growing species, such as *Martensii*, *Galeottii*, &c., cuttings for single plants may be rooted in the cutting-bench of the greenhouse; but for larger specimens they may be distributed, one to every inch, over a nine or ten inch pan, which will in a few months yield beautiful plants. They can be trimmed as freely as desired.

The following suggestion is offered by Smith in "Ferns, British and Foreign," p. 328:—

"If, however, good species are desirable, with an arrangement on a bench or low shelf, square pans about twice as high at the back as in front are in every way preferable. These are at Kew arranged alternately with the cases of *Hymenophyllum*, with which they harmonize."

Owing to the multitude of synonymes in use in naming collections of *Selaginellas*, great trouble

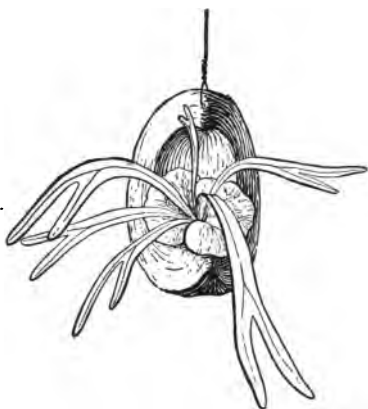
is experienced in ordering any particular species from a catalogue. The names given below were taken from a named collection at the Botanic Garden, Cambridge, Mass., and may therefore be relied upon as correct. The plants themselves, when the list was made, were in a most beautiful and healthy condition.

I. CLIMBING SPECIES.

- S. laevigata*, *Spring*. Sometimes known as *Lycopodium* (not *Selaginella*) *Willdenovii*, *S. casia*, *S. altissima*, &c. From East India. When trained in a pot as a climber, or left to itself in the fernery, it is a beautiful plant. When in good condition, the fronds are of a fine metallic blue. It needs the warmest place.
- S. Wallichii*, *Hort*. From Penang. Has fern-like fronds, and is well adapted for pot-culture.
- S. caulescens*, *Spring*. From the East Indies. May be trained into a most attractive exhibition-plant.
- S. inaequalifolia*, *Spring*. From East India. Is also a fine species.

II. ERECT SPECIES.

- S. Lyallii*, *Spring*. A tall-growing species of very handsome form. Needs warmth.
- S. viticulosa*, *Klots*. From Columbia. Fronds quite large, light green. A fine pan-plant.
- S. Parvillei*, *Spring*. Fronds larger and darker than the last.
- S. hamatodes*, *Spring*. Fronds larger and taller still, dark green, delicate, and very handsome.
- S. erythropus*, *Spring*. From Tropical America. Similar to above, but not so large as the last. It approaches the next species.



1.



2



3.

PLATE XX.

1. Suspended cocoanut-husk.

2. Wire basket.

3. Wire cylinder.

S. pubescens, *Spring*. This, when well grown, is one of the most beautiful of *Selaginellas*. It is often found under the name *S. Willdenovii*. The fronds frequently are two feet high.

III. PLANTS DECUMBENT, OR INCLINED TO BE SO.

S. Galeottii, *Spring*. Sometimes known as *S. Schottii*. From Mexico. This is a fine plant for baskets or for walls in the greenhouse. Is also excellent for the fernery; but it is difficult to keep it within the limits of a pan, as the numerous stems often shoot out to a great length.

S. atroviridis, *Spring*. From East India. A rather stiff species, with somewhat large fronds. Is interesting from its ruddy appearance.

S. Martensii, *Spring*. From Mexico. This is one of the most common as well as most useful species in cultivation. It is found under the names *Lycopodium stoloniferum* and *L. Brasiliense*. Its habit is to continually throw off roots from the backs of the fronds, like a miniature banyan: hence one of its names (*stoloniferum*). This species has been made to vary considerably. The *var. compacta* is more dense than the typical form, making quite bushy little plants when single. The *var. divaricata* is more delicate: the fronds are tipped with a light, almost golden, point; and the whole appearance of the plant differs widely from the other varieties. *Var. variegata* seems to be a variegated *compacta*. The fronds are often half white. By selecting the whitest from which to propagate, the variety may be kept for any length of time; but, if the cultivator is not careful, the green fronds will predominate, and the variety return to its original type. Like almost all variegated plants obtained by modifying species, there is in this variety an abnormal condition of existence: although this particular *Selagi-*

nella does not follow very closely the law that such variegated plants are less healthy than others, for its fronds are but slightly smaller than the ordinary green ones. The varieties of this species are just the plants with which to fill the shallow pans, or to use as undergrowth in ferneries. They will endure quite a cool temperature, and flourish in a hot one. They like shade, but will not die in full light.

So far, the species enumerated under the head "Decumbent" are those of larger and more erect habit. Among the creeping, low-growing sorts, are

- S. uncinata*, *Spring*. Called also *S. casia*. From China. A plant adapted to pot-culture or the fernery. The longer stems are stiff; and in the fall the plant has a beautiful color; but by spring the whole will have become withered, and look badly. It may then be cut in quite closely, and new shoots will soon develop.
- S. Krausiana*, *var.* A delicate plant, with a golden tip to each segment of the fronds. Somewhat like *S. Martensii*, *var. divaricata*, but more delicate.
- S. delicatissima*, *A. Br.* From Columbia. Also called *S. microphylla*, and is well described by either name. Like the last species, it is more adapted to pan-culture than for the fernery with other plants. In a small fernery, by itself, it can be managed without trouble.
- S. denticulata*, *Link.* A European species, the commonest in cultivation. It is even a weed in most fern-houses. It is very useful to cover any damp spot, and, for a fernery, is always pretty.
- S. Apus*, *Spring.* A native of N. America. It grows in damp, shady hollows. Is considered the same as the

more closely-growing *S. densa* so much cultivated. But, whether there are two species or one, the plants are charming. *S. densa*, when well started, forms a solid turf on a pan in a short time. Little tufts may be pricked out in different parts of the pan, and will grow together. This species does not generally thrive in the fern-case with other plants.

IV. PLANTS WITH FRONDS SPRINGING FROM A CENTRAL POINT.

S. convoluta, *Spring*. From Tropical America. Often called *Lycopodium convolutum* and *L. paradoxa*. A dark-green species, with rather rigid fronds.

S. involvens, *Spring*. From India. More circular in form. This and

S. cuspidata, *Link*, from Tropical America, are dry-looking species. In fact, all the *Selaginellas* in this section apparently grow in countries where there is a dry season at some time of the year. If not watered sufficiently, they will curl up rather than wilt as other species do.

S. pilifera. Another of the same general habit.

S. lepidophylla, *Spring*. From Mexico. This is the curious ball-like plant which in its dead and dry condition is peddled in the streets of Boston and other cities as the "resurrection-plant." When this dry ball is placed in water it soon unfolds, looking as if it were alive; but it is not, and many have been the disappointed persons who have vainly endeavored to make a specimen grow. The water is absorbed in a purely mechanical way by the plant, just as oil is drawn up into lamp-wicks by capillary attraction. The true "resurrection-plant," or "rose of Jericho," is the *Anastatica hierochuntina* of Syria, which is supposed by the superstitious to unfold yearly at the day and hour of Christ's birth.

The *Selaginellas* of the last division are rather hard to manage, and are only desirable as curious plants.

There are very few works available for the determination of the species of *Selaginella*. Spring's "Monograph of the Lycopodiaceæ" is the authority most in use. A few plates of different species of *Selaginella* are given in some of the works of Sir W. J. Hooker: others may be found in the horticultural publications. For investigating the structure of these plants, Sachs, Hoffmeister, and LeMaout and Decaisne, may be consulted.





CHAPTER XVII.

FLOWERING-PLANTS TO GROW WITH FERNS.

NO extended lists of plants will be attempted in this chapter; but suggestions will be given as to the classes of plants most suitable for cultivation with ferns.

In house-culture, particularly in the tropical house, the various species of Palms are frequently grown with fine effect. The catalogues of dealers in rare plants, either on this or the other side of the Atlantic, will give the prices and sizes of these; and a reference to such books as Martius' "Genera and Species of Palms" will enable the purchaser to form some idea of the shape of their fronds and their mode of growth. It also is frequently the case that the dealers' catalogues are themselves well illustrated.

The *Aroideæ* contain many plants, especially the highly-colored *Caladiums*, well adapted to grow with ferns.

One of the most magnificent plants that can be

cultivated is one of the bananas, — the *Musa Ensete*; but it could only, of course, be grown in a large greenhouse.

The *Begonias*, especially those after the pattern of *B. rex*, are always desirable. They are easily managed in the greenhouse or fern-case.

The moist air of the fern-house seems exactly what is required for the treatment of *Orchids*; but the expense which these plants involve prevents their cultivation becoming common. But where the owner of the house has time to tend and watch them, or a gardener is always in attendance, they should not be omitted. The first thing to be done by any one who proposes to grow *Orchids* is to obtain Williams's "Orchid-Grower's Manual;" or "Orchid Culture," by Edward S. Rand, jun. (Hurd and Houghton, 1876). The latter is slightly the more expensive. These books contain descriptions of the best *Orchids*, and information concerning their management.

Among the smaller plants suitable for ferneries are the *Fittonias*, the very pretty variegated *Panicum*, various *Marantas*, and, until it outgrows its quarters, the *Coccoloba platyphylla*. The *Ficus repens* will in a short time form a beautiful covering on the wall of the greenhouse, and will also thrive in the fernery.

Reference has already been made to plants which may be grown in the out-door fernery.

This is one of the places which should be devoted to experiments ; one of its greatest charms being the discovery, as spring opens, of plants in good condition which had been placed there the season before, with some misgivings as to their survival. It is possible, at very little expense of money or trouble, always to bring something to the fernery from our short journeys or country walks ; and the experiments thus tried serve both to interest us at the time, and add to the plants to be watched for and hailed with pleasure as other seasons come.





CHAPTER XVIII.

FERN-PESTS.

EVERY one who cultivates ferns, whether in doors or out, in pots or in ferneries, will, sooner or later, find that his pets are liable to trouble from animal or vegetable pests, and that some of these are only with great difficulty to be exterminated.

The common plant-lice (*Aphis*, Pl. 22, Fig. 9), of which there are at least two species, collect on the young fronds, and, owing to their gemmiparous method of reproduction, increase with astonishing rapidity. Dr. Packard, in his "Guide to the Study of Insects," states that it has been shown, that, by this process, nine generations may be produced, and in one case eleven generations were obtained, in seven months. Ants, which do no particular harm themselves, are very fond of the sweetish secretions of the *Aphides*, sometimes guarding them for future use.

The *Aphis* may be destroyed by tobacco-smoke.



PLATE XXI. CHINESE STAND.



In fact, if the greenhouse is smoked lightly every week, as it should be, very little trouble will be experienced from this source. When house-plants or ferneries are attacked by them, the *Aphides* may be readily removed by using a soft brush.

The *Thrips* (*Heliothrips hæmorrhoidalis*, Pl. 22, Fig. 2) is much harder to manage. These insects generally collect unobserved on the under side of the fern-fronds, where they increase greatly, and injure many plants before their presence is suspected. They live upon the cuticle of the frond or leaf, causing it to turn brown or whitish. The insects in the larval state are white, the adults black or dark brown. These are so small, — being only about the sixteenth of an inch in length, — that they are hardly noticeable without a glass, and are with difficulty removed by mechanical means. Smoking which will keep the *Aphis* in check will not dislodge the *Thrips*, while smoke sufficiently strong to kill the *Thrips* will be sure to injure the more delicate plants. The best method is to select some time when dull weather is expected, and give the house, three evenings in succession, as much smoke as is safe. This will usually dispose of the *Thrips*; but, if unsuccessful, repeat the operation soon. One gardener says that he judges of the necessary quantity of smoke by tasting the leaves of several plants: if the tobacco is perceptible, he feels that the *Thrips* must have been killed.

The mealy-bug (*Coccus*, Pl. 22, Fig. 6) is seldom found in the fern-house, as the dampness required for the health of the ferns is too great for its well-being; and as the males are winged, and are destroyed by smoke, the females seldom increase sufficiently to do any harm. Should they, however, become troublesome, a smart syringing will usually dislodge most of them: the rest can be destroyed by a small stiff brush or little pine stick. Kerosene is frequently recommended for killing the mealy-bug; but, in the hands of a beginner, it is a dangerous remedy.

The various scale-lice (*Lecanium* and *Aspidiotus*) are usually found on the stipes and rachis of the fern. They cannot be made to relinquish their hold by any such mild treatment as will dispose of the mealy-bug. It will generally be found necessary to remove each plant attacked to some suitable place, out of doors if possible, where the scale-lice must be carefully removed either with a little stick or the finger-nail. The plant must afterward be washed with soap and water, to remove any eggs that may adhere to it. Dr. Packard speaks of several species of these insects which have attacked the plants in the Amherst and Cambridge greenhouses. The *Lecanium filicum* preys on the strong-growing ferns. It is shown, highly magnified, in Pl. 22, Fig. 8, as seen from above, and in Fig. 7 from underneath.

L. platycerii (Pl. 22, Fig. 5) is found on the Stag's-Horn Fern (*Platycerium*), where it does much mischief. The *Aspidiotus bromelii* is another of these pests. The scale-lice are themselves sometimes attacked, as is the *Aphis*, by parasites. A minute ichneumon-fly pierces the outer shell of the scale, and deposits its eggs within. These are hatched, and the larvæ, feeding on the scale-contents, soon destroy their host. When perfected, the little ichneumons fly away to repeat this process on other scales. Dr. Packard, judging from his observations, thinks that a great many scale-lice are thus destroyed.

The red spider (*Tetranychus telarius*) ought not to be found in any fern-house, as its presence plainly shows that the temperature is too high, and that the atmosphere of the house is not sufficiently moist. The red spider, as well as the *Thrips*, will first attack plants which are not in their most healthy condition, as is the case when plants which naturally require a temperate heat are kept in the tropical house. Among the ferns most frequently assailed are *Pellæa hastata*, *Lomaria ciliata*, *L. gibba*, and *Aspidium falcatum*.

The red spider belongs to the family of mites. It can hardly be seen without a glass; but, when collected in quantities, the insects give the fronds a rusty appearance; and, if the fingers are drawn over the fronds, they will be stained a reddish

color. We can soon rid ourselves of this pest by sprinkling the plants, particularly the under side of the fronds, with water, at evening, or in the day-time during cloudy weather.

Among larger pests are the snails. Both the *Helix*, and the soft, shell-less, slimy *Limax*, sometimes called "slug," quickly eat the new fronds and young plants, and will cause much trouble in a short time if suffered to increase. They are found in both the in and out door fernery. They may be detected, inside, by their shining trails of slime where they have marched across the glass or plant-stems. All of these snails are very fond of apple or potato, and can be trapped by leaving in their way slices of these or other juicy morsels to attract them. If such baits are put at evening under the moss or leaves, or on the greenhouse shelves, the snails or other vermin which have collected to feed upon them may the next morning be killed.

The sow-bug (*Porcellio*), one of the *Crustacea*, frequents places where ferns are cultivated. This creature lives upon dead organic matter, and probably does no harm to the plants. Sow-bugs may be caught by inverting flower-pots with moss or leaves in them to serve as traps: they will collect under these covers. Or they may be hunted under boards or loose stones.

Among fern-pests in the New-England States



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2.



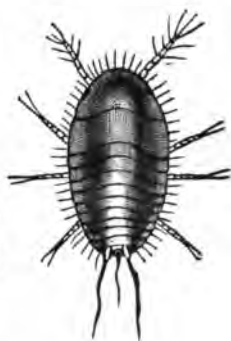
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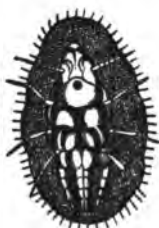
3.



6.



5.



7.



9.



8.

PLATE XXII. FERN PESTS.

[illegible]

is one European snail (*Helix cellaria*), which, like many of our garden nuisances, has been transported from across the ocean, very probably with some choice plants, around which an unusual amount of packing had been placed for more complete protection.

The earth-worm (*Lumbricus*), when confined to the narrow limits of a flower-pot, causes considerable trouble by its tendency to turn things upside down, but in the larger spaces of the greenhouse, and out of doors, does probably more good than harm.

The larva of a saw-fly (*Abia caprifolii*, Pl. 22, Fig. 3), which feeds upon the honeysuckles, and also the currant-worm, have attacked the fronds of *Onoclea* and *Osmunda* in the writer's open-air fernery, causing much damage. As they are quite large, they can be easily seen and picked off; or, better still, perhaps, the plants can be dusted with hellebore or some of the so-called Turkish insect-powders.¹

English works complain of the ravages of beetle-grubs, especially that of the *Otiorhynchus sulcatus*, which infests ferneries; and Dr. Packard states that "a weevil somewhat like *Otiorhynchus* infests

¹ While the writer has been at work on this very chapter, two beautiful specimens of *Botrychium Virginianum* in his collection have been destroyed by a cut-worm, their withered fronds lying on the ground to tell the tale.

the plant-house at Amherst." According to Smith, in England "few plant-houses are exempt from the ravages of the cockroach;" but they are not often found in greenhouses on this side of the Atlantic. If, however, they should be discovered, traps may be set for them in the same manner as for the snails. "Another insect, the *Aleurodes vaporarium*, feeds on the cuticle of the fronds, darting off, when disturbed, like a flock of pigeons." This insect has been observed in Salem. It belongs to the mealy-bug family, and is shown at Pl. 22, Fig. 4, in the young or larval condition; Fig. 1, full grown.

Under certain conditions various leaf-fungi attack the ferns. Among them is the "sooty mildew," which quickly covers the fronds of large species. The *Uredo filicum* *Desm.* assails different species in the open air, as well as in the greenhouse; and frequently the fronds of *Pteris aquilina* will be disfigured by patches of *Dothidea pteridis*, *Fr.*, which so much resembles the fructification of ferns, that it is sometimes mistaken for this by inexperienced persons. The same thing occurs with *Aspidium marginale*. Only the first of these fungi does much injury to the ferns. The treatment advised to destroy this is "dusting with sulphur, or washing and syringing." Sulphur must be always used with care in a greenhouse; for should even a very small quantity fall on the flues, and ignite, the

fumes evolved would be sure destruction to the plants in the collection.

Rabbits are in England complained of as interfering with the out-door cultivation of ferns. But the writer has found his chief trouble to arise from the midnight revels of the cats of the neighborhood, which seem in the spring (the time when most damage can be done by breaking down the new fronds, and uprooting the young plants) to consider the "wild corner" a particularly favorable place for their frolics. A box-trap, followed by a short course of hydropathy whenever a patient presents himself, has greatly alleviated this annoyance; and the evil, when dead, becomes a blessing in the shape of a stimulant at the roots of pear-trees and grape-vines. A friend has lost a fine collection of out-of-door ferns by the ravages of hens, which seemed to consider the young crosiers very delicate food. All these and many other annoyances must be met with good-temper, patience, and mother-wit by every one who would be successful in the culture of ferns.





CHAPTER XIX.

CONCLUSION.

IN conclusion, the writer has but a word to say. There is a large class of persons who are so fortunate (or unfortunate, according as they use or abuse the privilege) as to have nothing to do; or, to speak more exactly, have to do only what they choose. This class must have a hobby, or they will *rust* out. Another class are engrossed by incessant professional work which leaves them every day cross and tired. These should have some outside hobby, or they will become one-sided and crabbed, and *wear* out.

Dr. Jacob Bigelow of Boston, being a hard and earnest worker in his profession, determined, for his own good, to select some sensible form of recreation; and chose the study of botany, as necessitating long walks and refreshing thoughts. The result was the publication, in 1814, of his "Florula Bostoniensis," which, enlarged and im-